Last time

- Electrical shielding
- More on the electric properties of conductors and Gauss's law
- Activity #5

This time

- More on the electric properties of conductors and Gauss's law

Summary of conductors and electric field

A conductor in **electrostatic equilibrium** has the following properties:

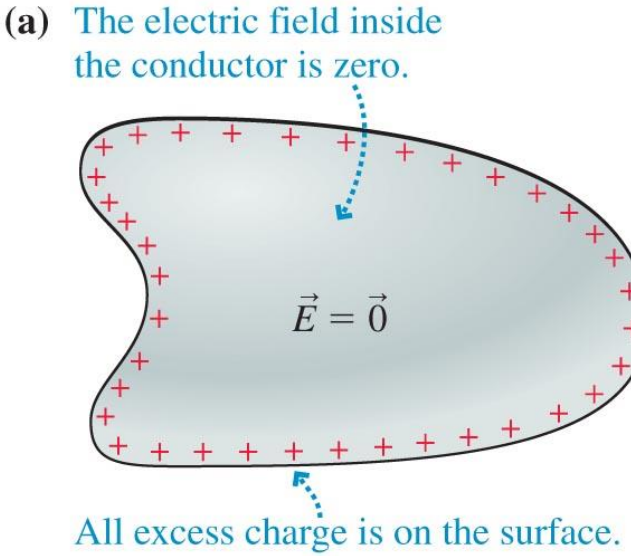
1. The electric field is zero inside the conductor.

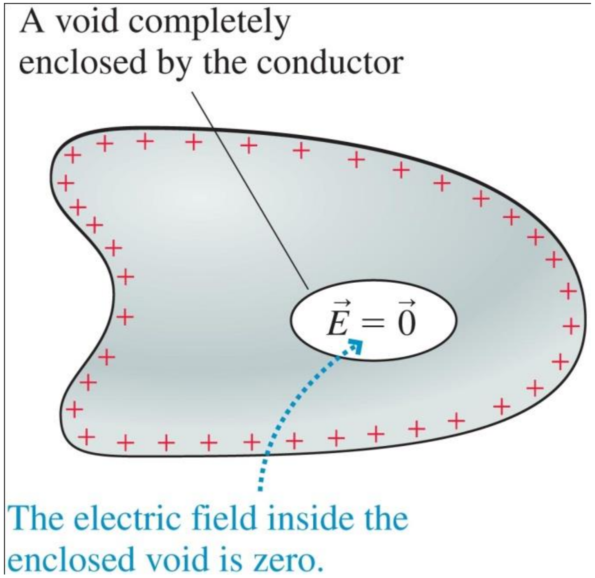
2. Any excess charge on an isolated conductor must reside on the surface.

3. The electric field just outside the conductor is perpendicular to the conductor's surface and has the magnitude of σ / ε_0.

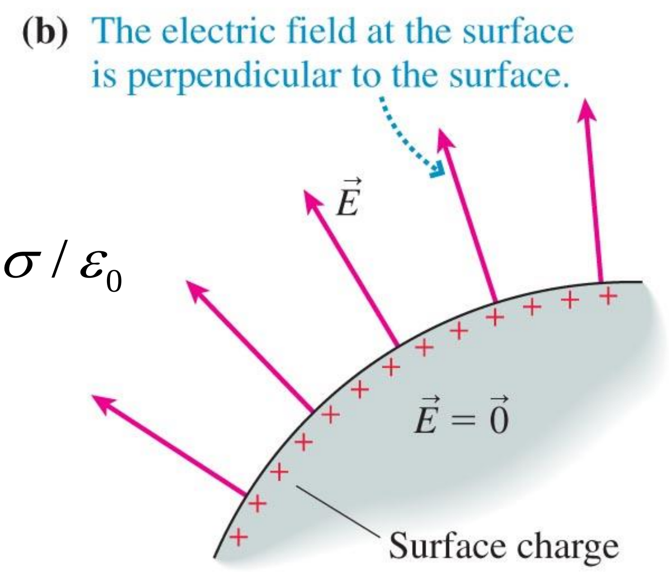
4. On an irregular shaped conductor, charge tend to accumulate at the locations where radius of curvature of the shape is smaller, **sharper edges accumulate higher surface charge density.**

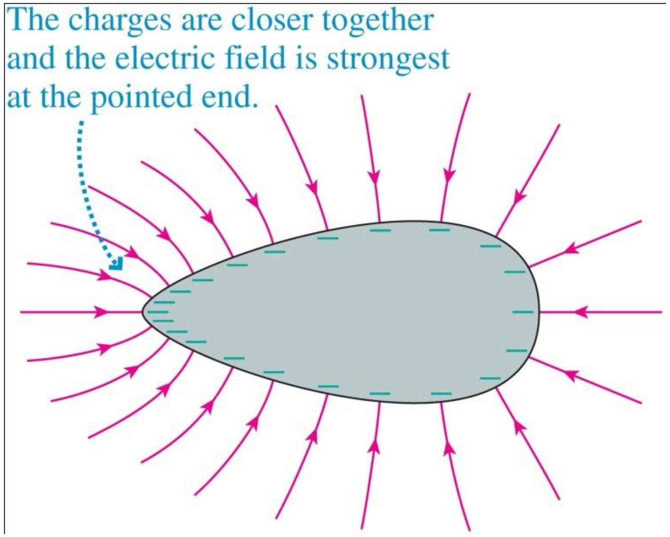
Summary of Conductors and Electric Fields



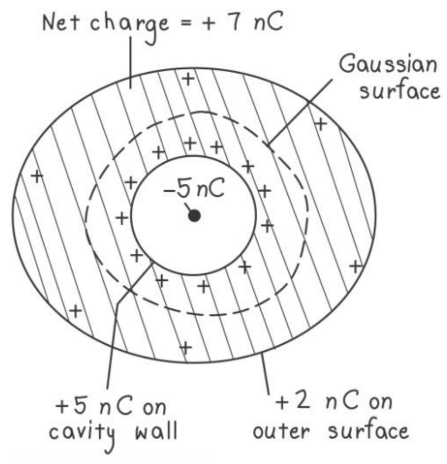


$$E = \sigma / \varepsilon_0$$





Charges on conductors

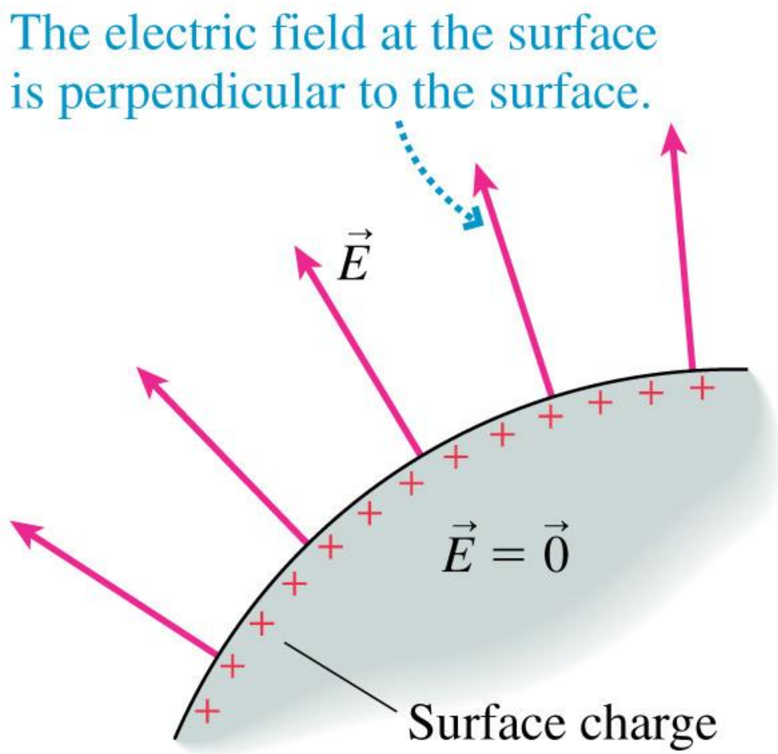


Starting with a conductor whose net charge is +7 nC initially and has a cavity.

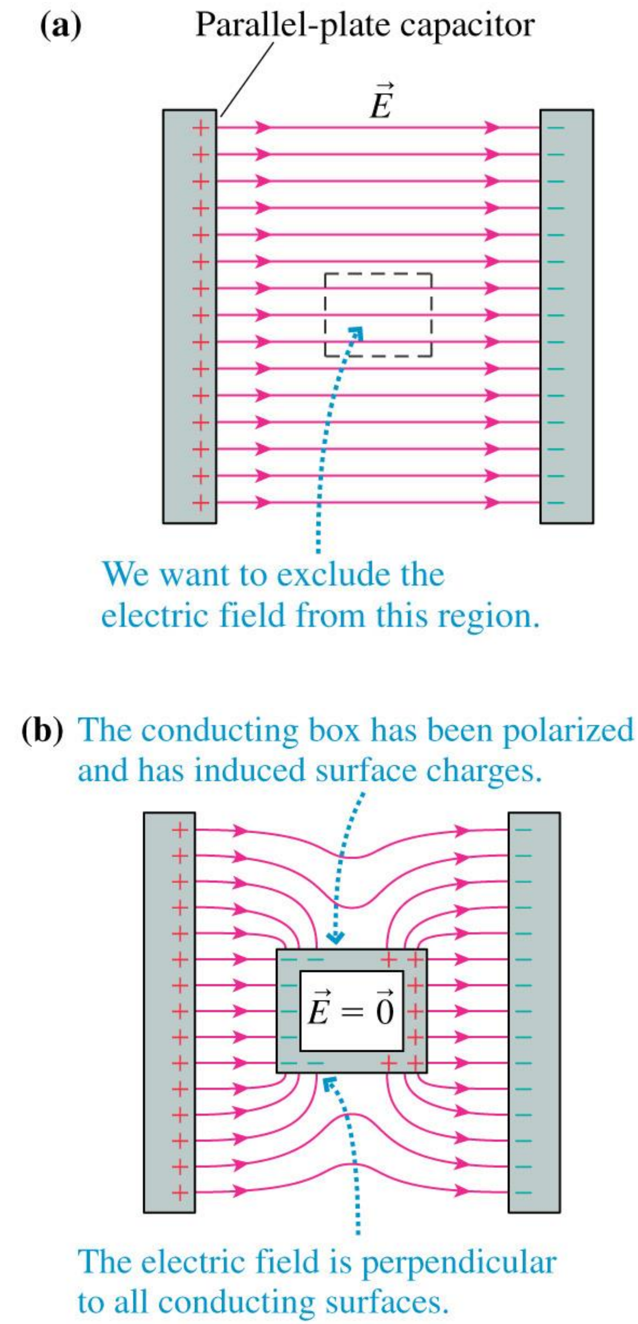
Of course, this charge resides on the outer surface of the conductor.

After a charge of -5 nC is placed at its center of the cavity, the outer surface will have a charge of +2 nC and the inner surface will have a charge of +5 nC.

In this way we satisfy the conservation of charge and Gauss's law.

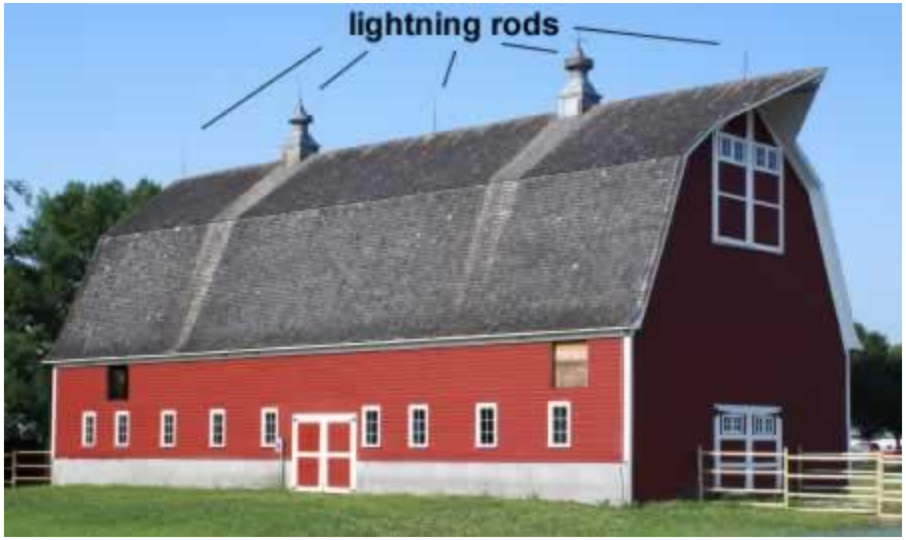


The electric field at the surface is perpendicular to the surface.
$\vec{E}$
$\vec{E} = \vec{0}$
Surface charge



(a)
Parallel-plate capacitor
$\vec{E}$
We want to exclude the electric field from this region.
(b) The conducting box has been polarized and has induced surface charges.
$\vec{E} = \vec{0}$
The electric field is perpendicular to all conducting surfaces.

Charged clouds above the building will induce charge on the roof. Lightning rods are designed to create a large electric field at the tip causing a gentle and faint discharge of air which discharges the roof before a lightning bolt strikes the building.

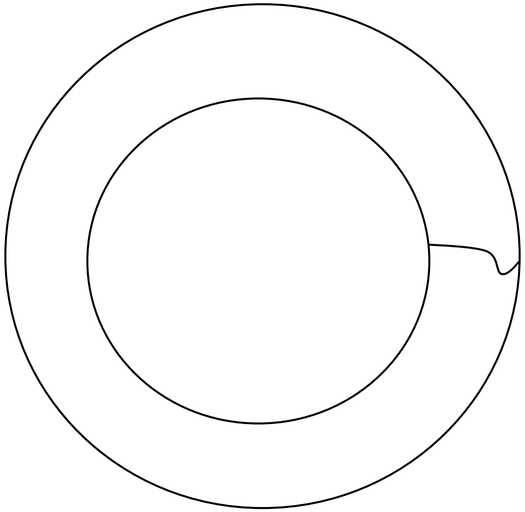


Friction with air charges the body of the air plane. Lightning rods with a high charge density (large electric field) at the tip create gentle and faint discharges of air, thereby discharging the body of the airplane.

Lightning rods on an airplane wing

Put a net charge of +q on this system.

Where does the charge go and why?



Thin spherical conducting surfaces connected by a thin conducting wire

Put a net charge of -q on this system.

Where does the charge go and why?

The charge goes to the outer surface regardless of its sign.