University Physics 2
(Calculus Based)

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Please pick up syllabus.

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Today

- Course Overview
  - Syllabus
  - Blackboard
  - course web site
    - see course home page: madisoncollegephysics.net/fall24physics2
  - Homework 1
- Introductions
- Clickers
- Chapter 5: Electric Charges and Fields

Clickers

- pick up a clicker
  - write down its number
- power on
  - replace (3) batteries if needed
- click in
  - make sure you get a green light

Electricity and Magnetism

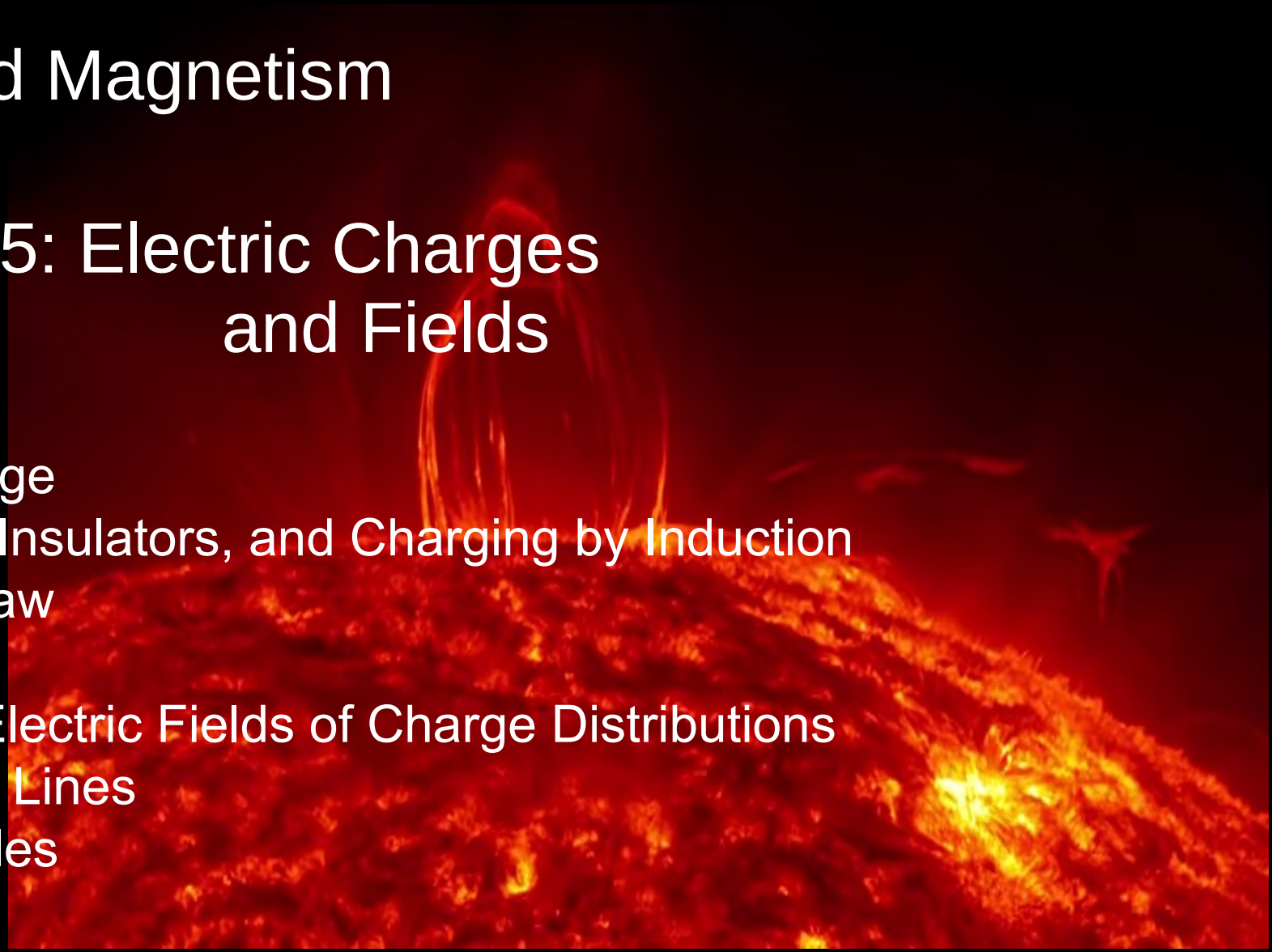
$$F = G\frac{m_1 m_2}{r^2}$$

$$F = k\frac{q_1 q_2}{r^2}$$

NASA Solar Dynamics Observatory http://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=11168

Electricity and Magnetism

Chapter 5: Electric Charges and Fields



5.1 Electric Charge
5.2 Conductors, Insulators, and Charging by Induction
5.3 Coulomb's Law
5.4 Electric Field
5.5 Calculating Electric Fields of Charge Distributions
5.6 Electric Field Lines
5.7 Electric Dipoles

Electric Charge

- positive and negative, carried (ordinarily) by the proton and electron

- Symbol q (or Q); units Coulombs (C)
- charge is quantized, appearing in multiples of

  $e = 1.602 \times 10^{-19}$ C

- electrons can easily move around to charge objects
  - protons are not mobile

Materials: Conductors & Insulators

- charges (electrons) move easily through a conductor
  - charges in a conductor are like small balls in a jar that repel each other
- charges cannot move through an insulator
  - however an insulator can become electrically charged

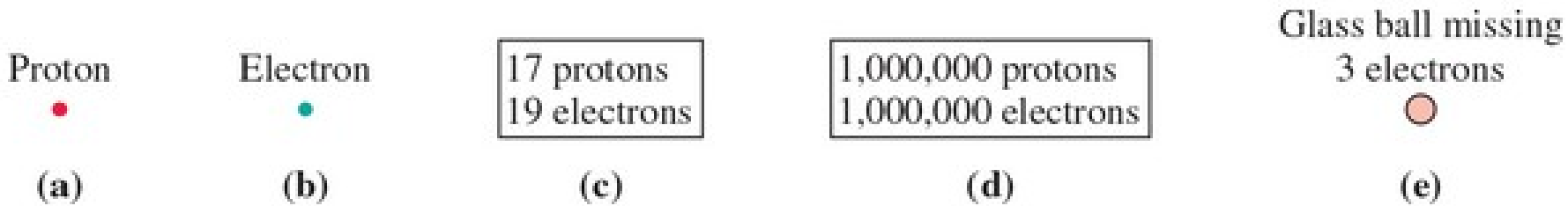
Other materials:

semiconductors: electrical conductivity can be controlled

superconductors: zero resistance to electron flow

Electric Charge

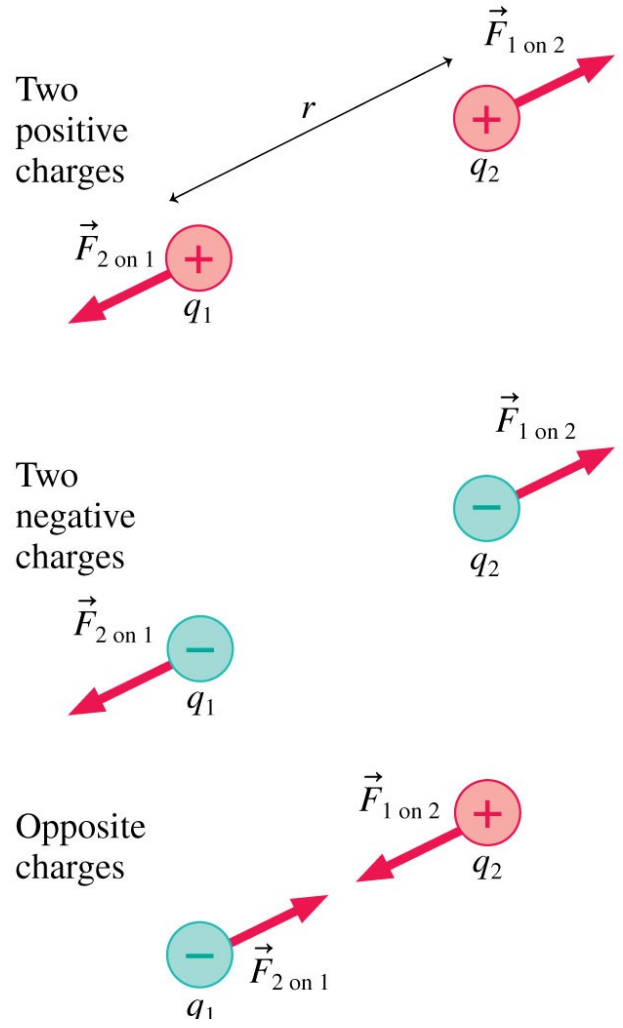
Which has the most negative net charge?



Coulomb's Law

The force exerted by charge 1 on charge 2 is

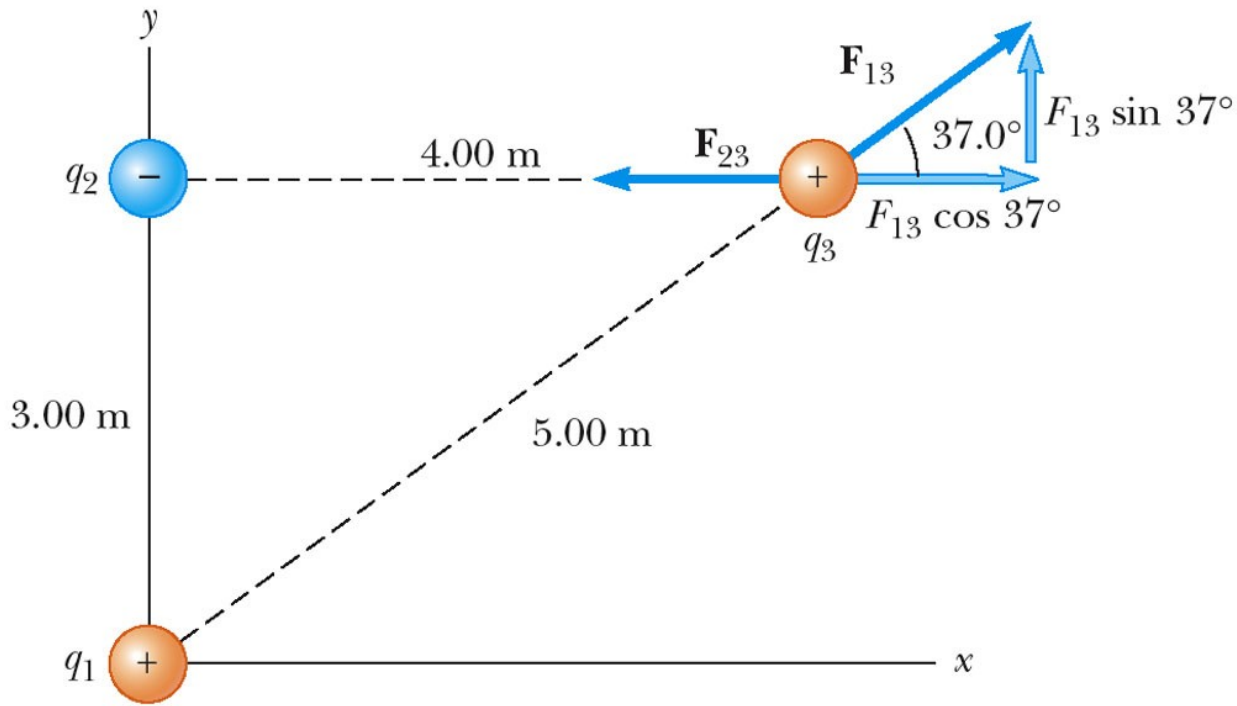
$$\vec{F}_{1\to 2} = k\frac{q_1 q_2}{r^2}\hat{r}_{1\to 2}$$



Coulomb's Law

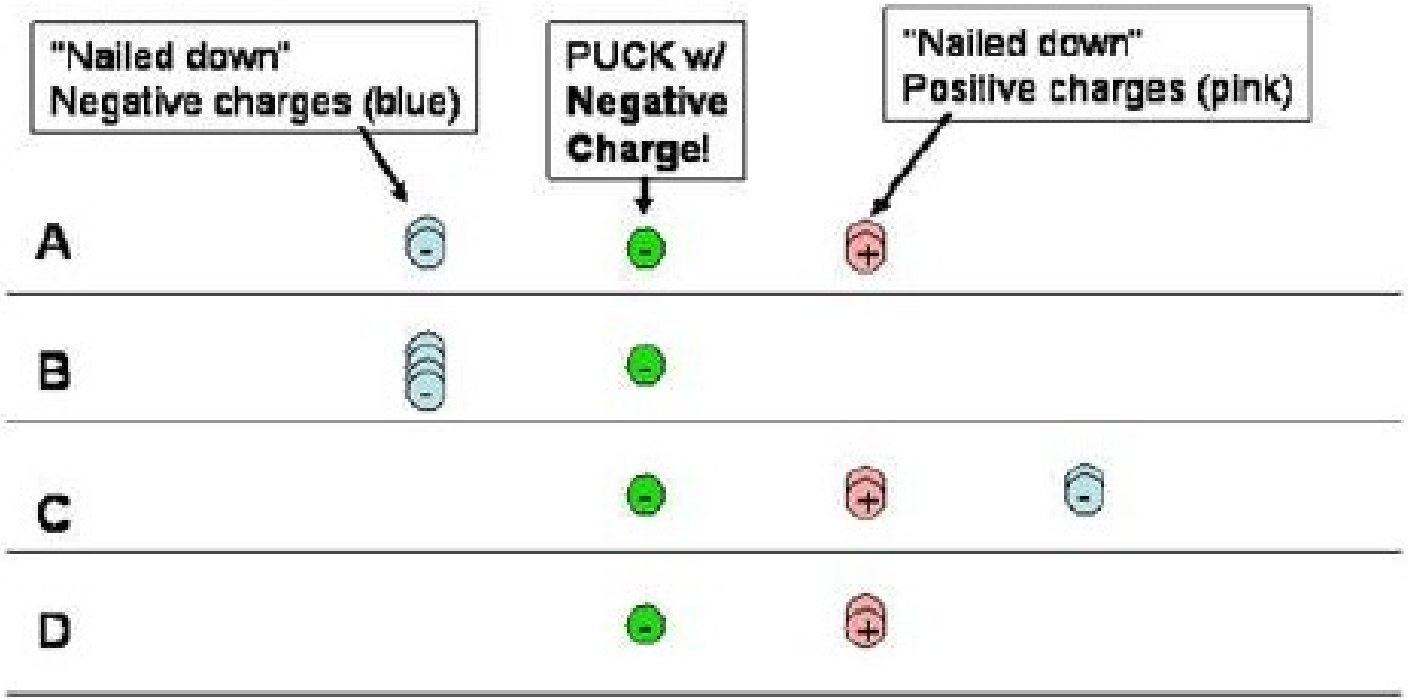
The net force on charge 3 is a vector sum.

$$\vec{F} = \vec{F}_{13} + \vec{F}_{23}$$



Coulomb's Law

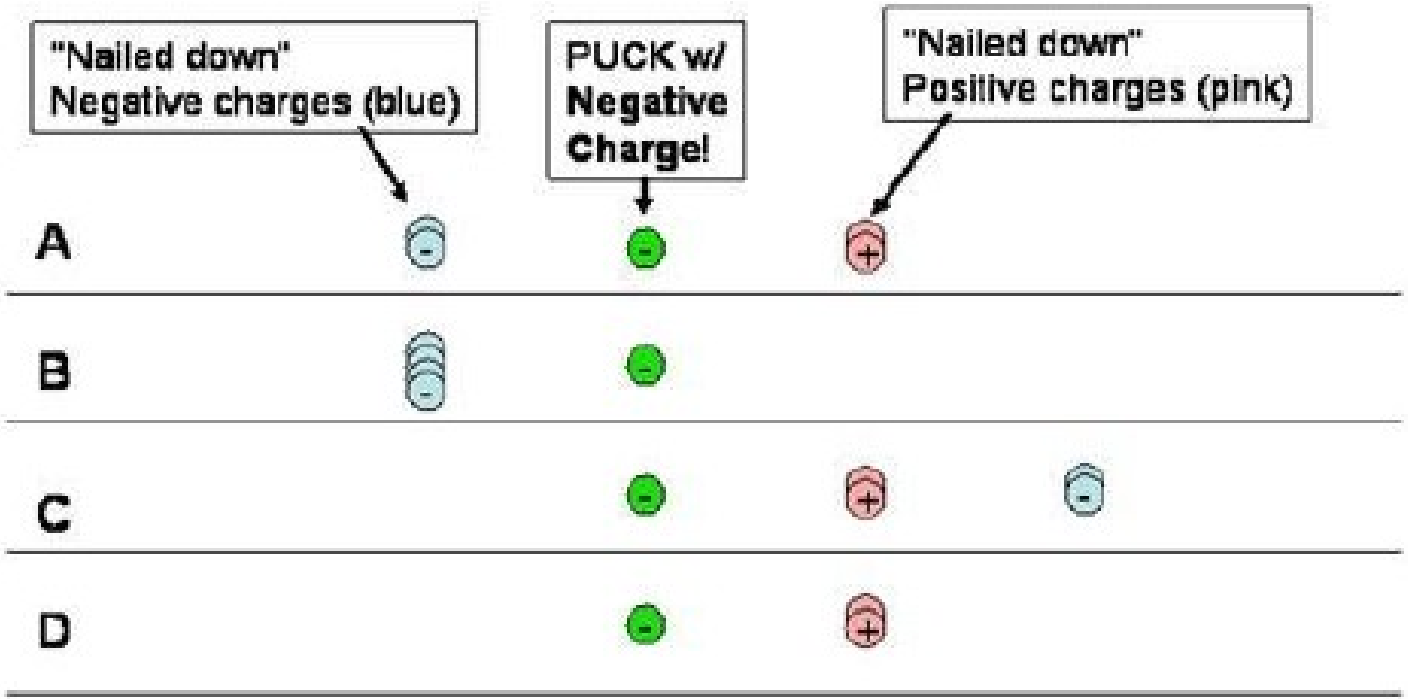
Which of the green "pucks" feels a net force to the left?



E. none of them

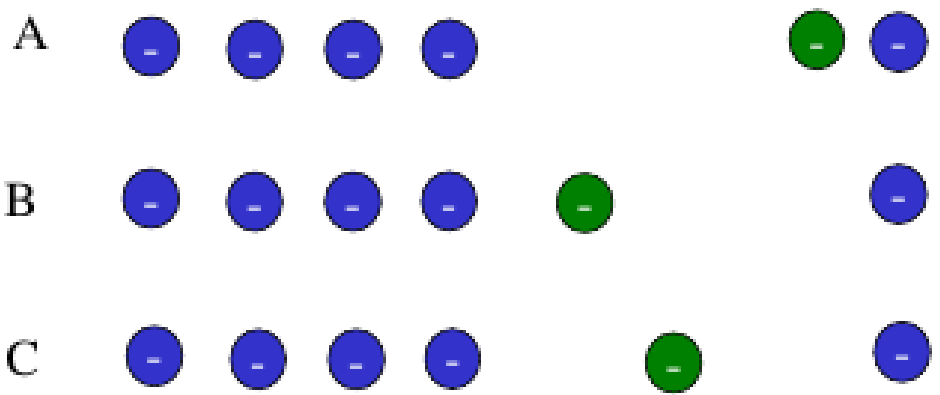
Coulomb's Law

Which puck feels the greatest force?



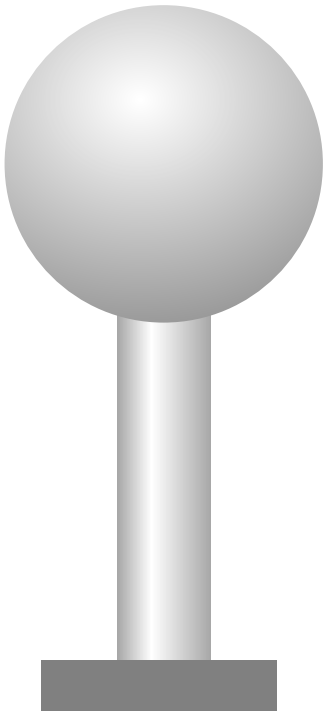
Coulomb's Law

Which puck is most likely to not move?



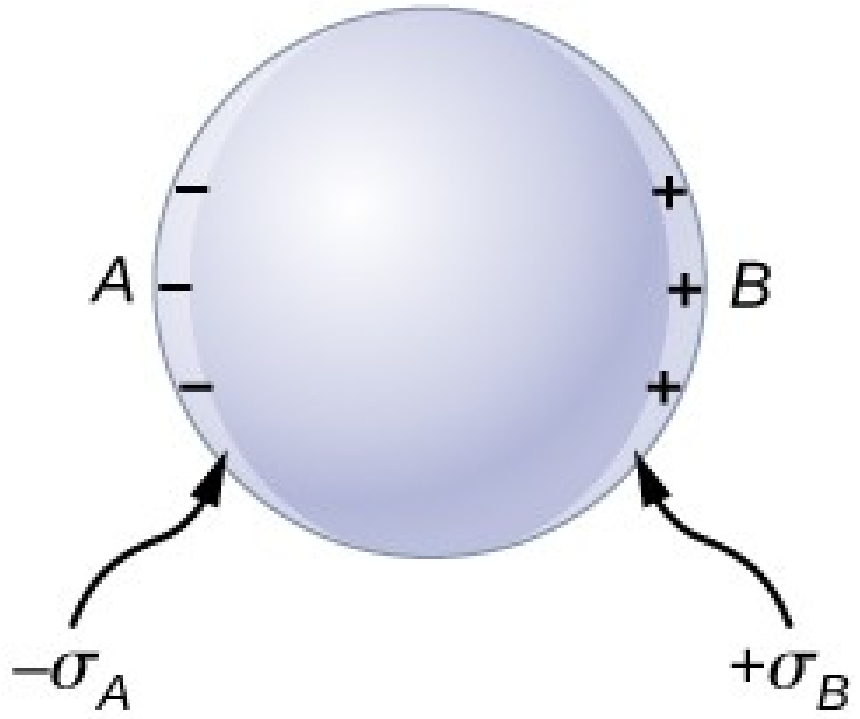
Conductors

A neutral conductor is full of positive and negative charges, free to move.



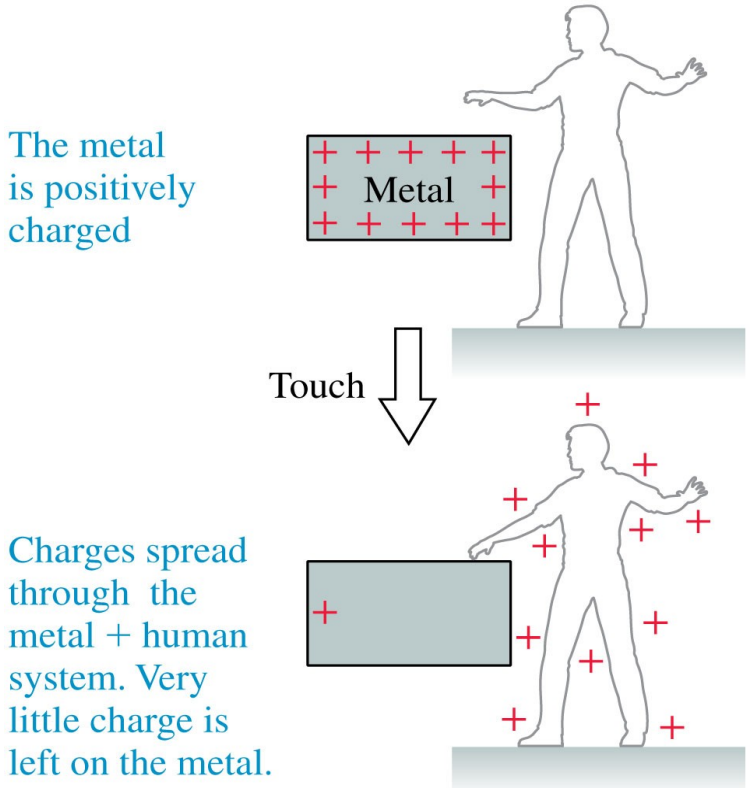
Conductors

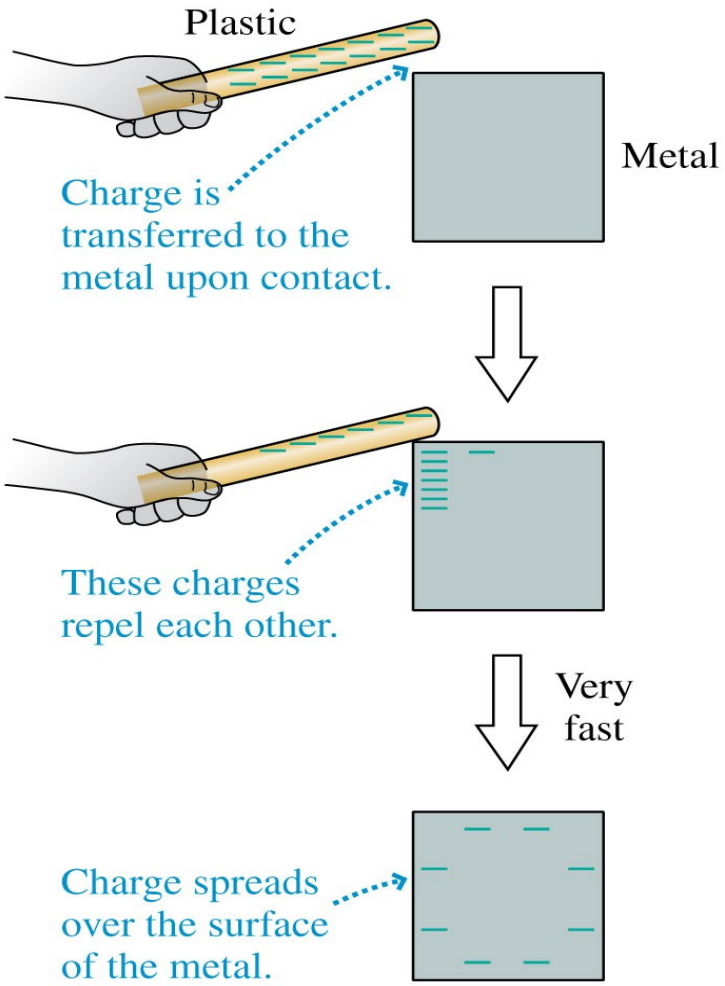
What happens when you bring an external charge near a conductor?



Charging a Conductor

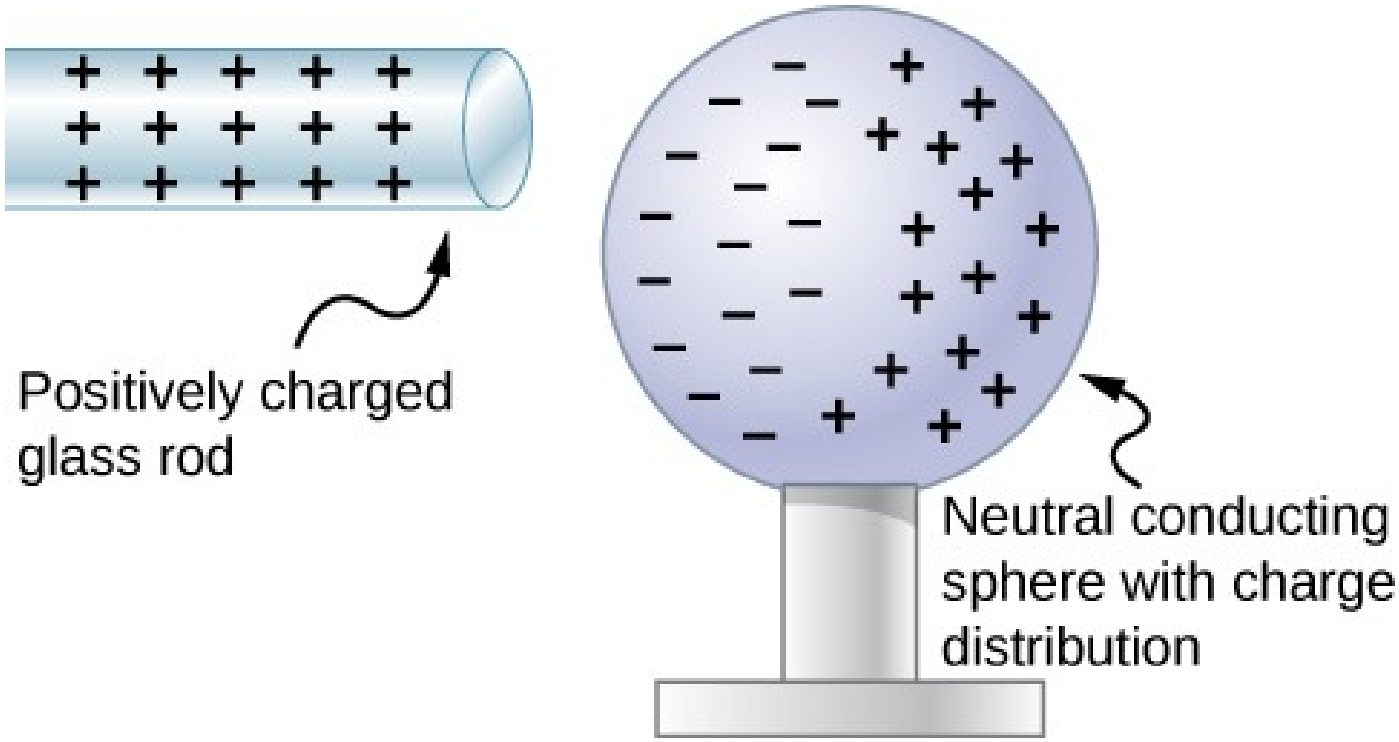
charging by conduction:





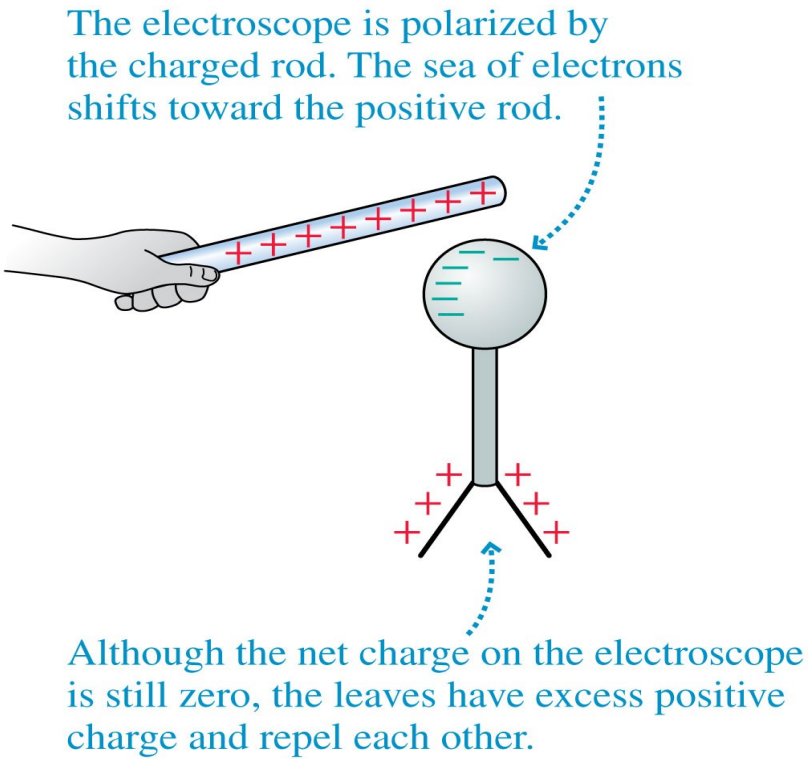
Charging a Conductor

charging by induction:



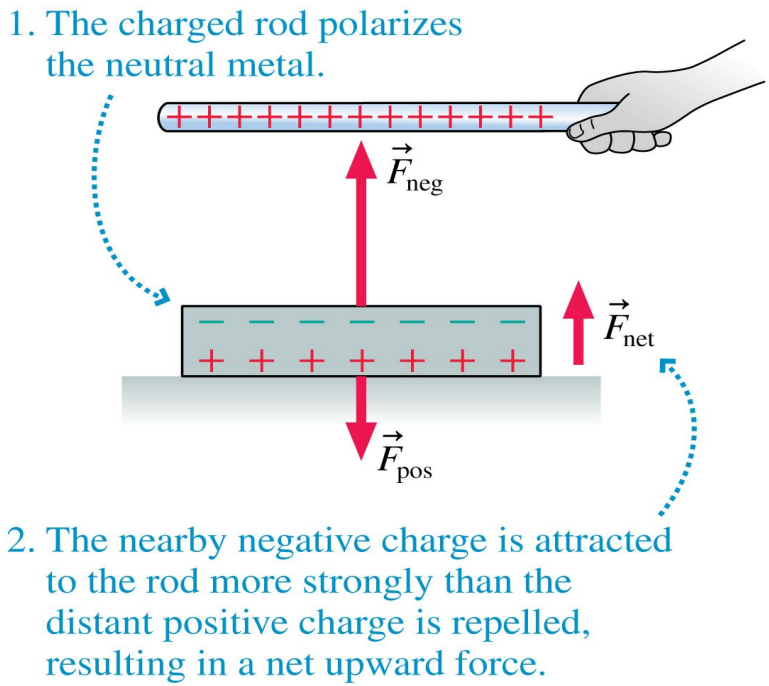
Charging a Conductor

charging an electroscope by induction:



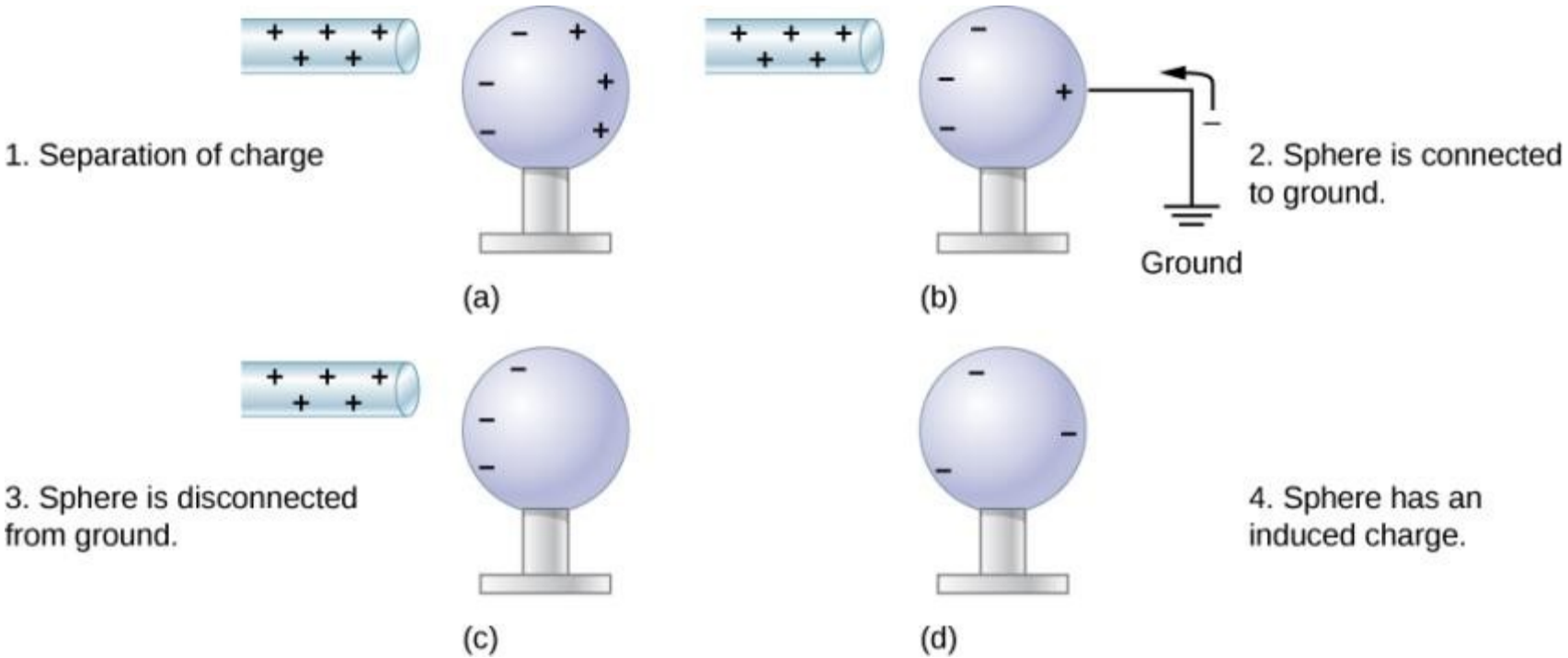
Charging a Conductor

charging by induction:

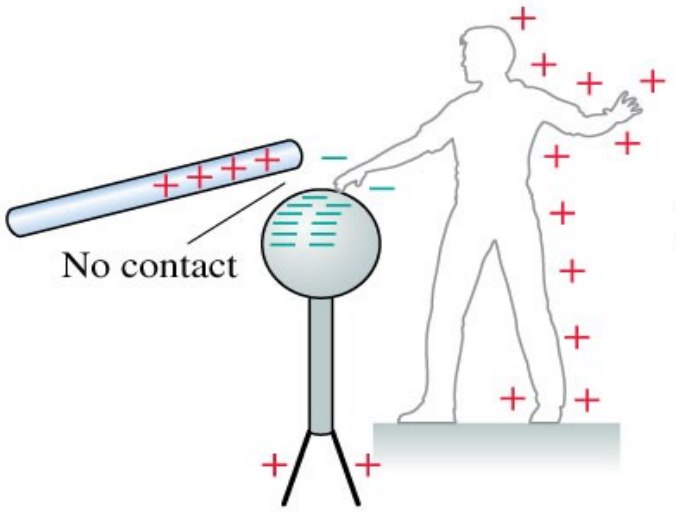


Charging a Conductor

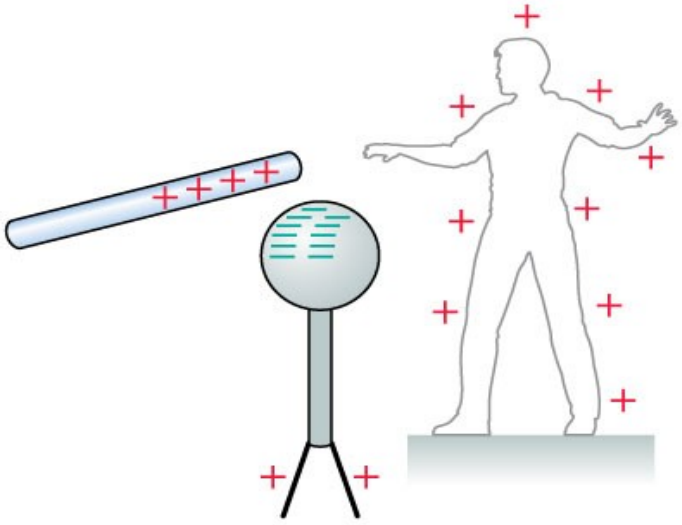
charging by induction:



Charging a Conductor



1. The charged rod polarizes the electroscope + person conductor. The leaves repel slightly due to polarization.



2. The negative charge on the electroscope is isolated when contact is broken.