

Conductors and Insulators

PHY 114-01

Fall 2026

Welcome!

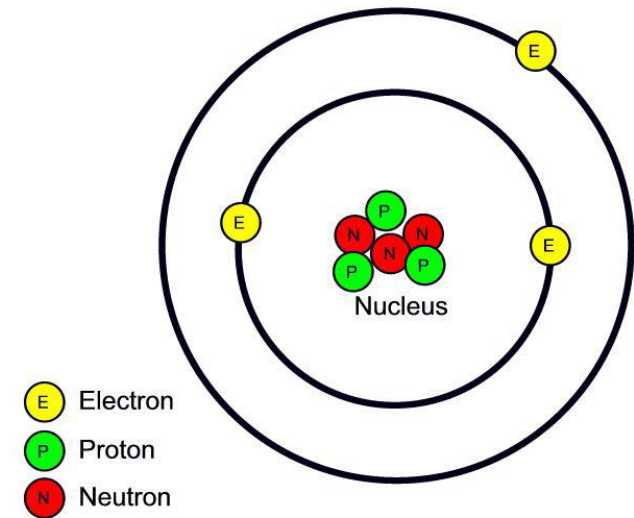
- Take a hand-out
- Sit next to at least one person to work with
- Discuss: what did you do over the long weekend?

Agenda

- Last time:
 - Properties, behaviors, and sources of electric charge
- This time:
 - Behavior of charge in materials
 - Charge transfer

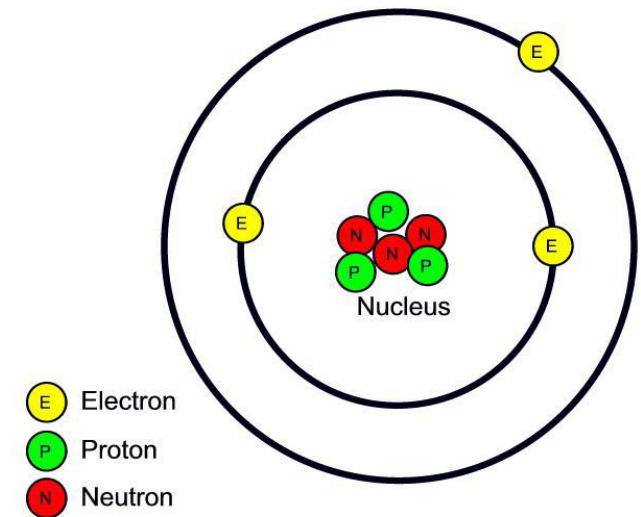
Where does charge come from?

- In a material, electrons can be pulled off but the nucleus stays behind.
- Electrons are defined as negative charge
 - Deficit of the charge carrier makes a positively charged object
 - Excess charge carrier makes a negatively charged object



Where does charge come from?

- Electrons close to the nucleus are bound tight.
- Electrons far from the nucleus can move more
 - In some materials, the electron cloud can be deformed
 - In some materials, the outer electrons can move freely between atoms



Conductors

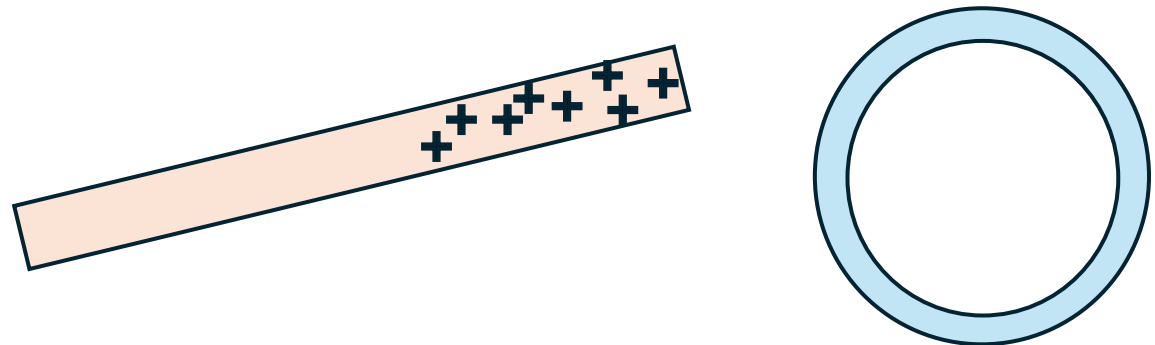
- Outer, or conduction, electrons move freely
- Charge can flow through material
- Typically metals

Insulators

- Do not have free (conduction) electrons.
- Charge remains localized. No flow!
- Most materials are insulators.

An experiment

- What happens when we put a charged insulator near a conductor?
- Consider some charged insulated rod and an empty soda can.
- Will the soda can
 - A. Be attracted to the charged insulator
 - B. Be repelled from the charged insulator
 - C. Nothing will happen
 - D. I have no idea!

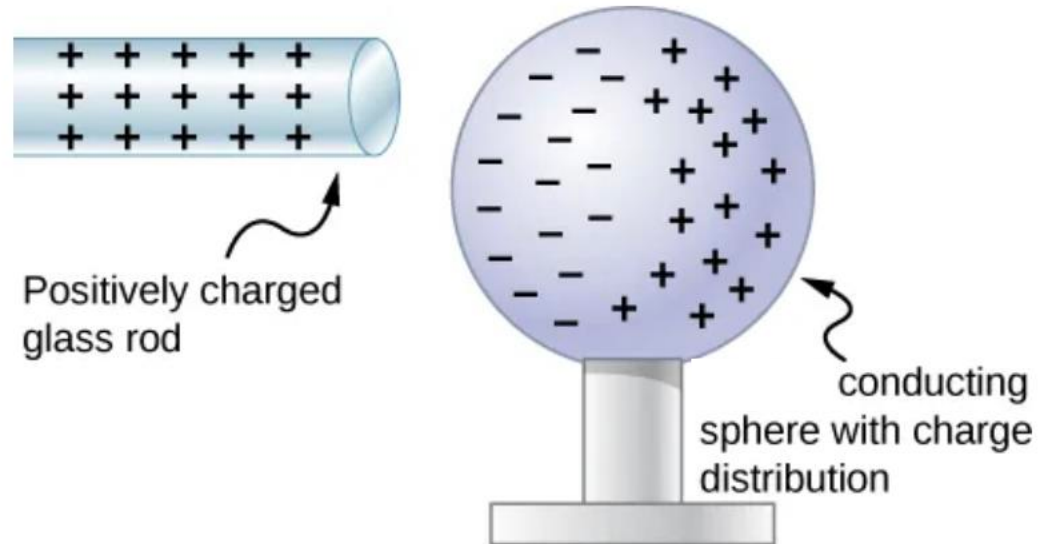




<https://www.youtube.com/watch?feature=oembed&v=9O7a9WFo0BA>

Polarization in Conductors

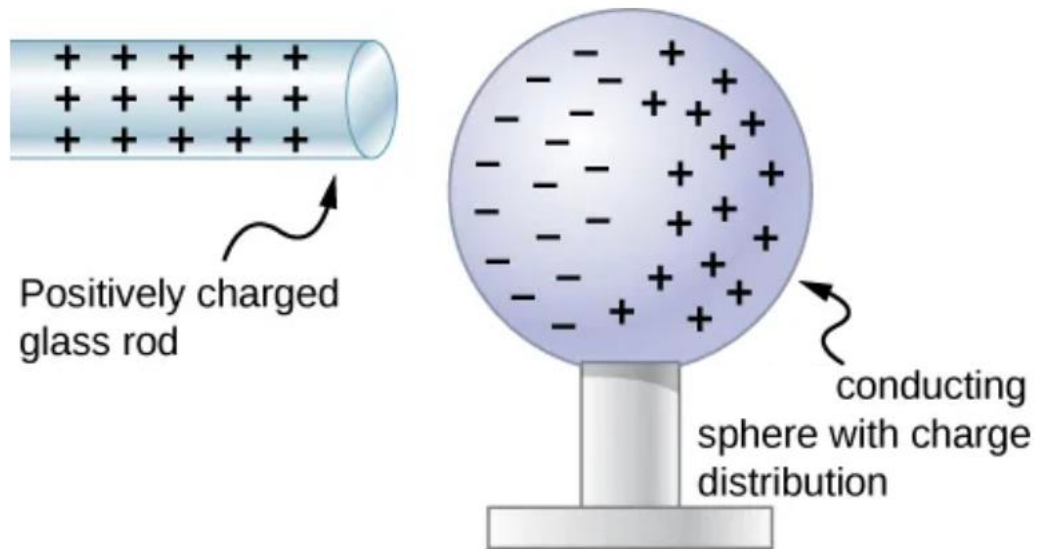
- Induced charge distribution
- Called a dipole



Activity

Polarization in Conductors

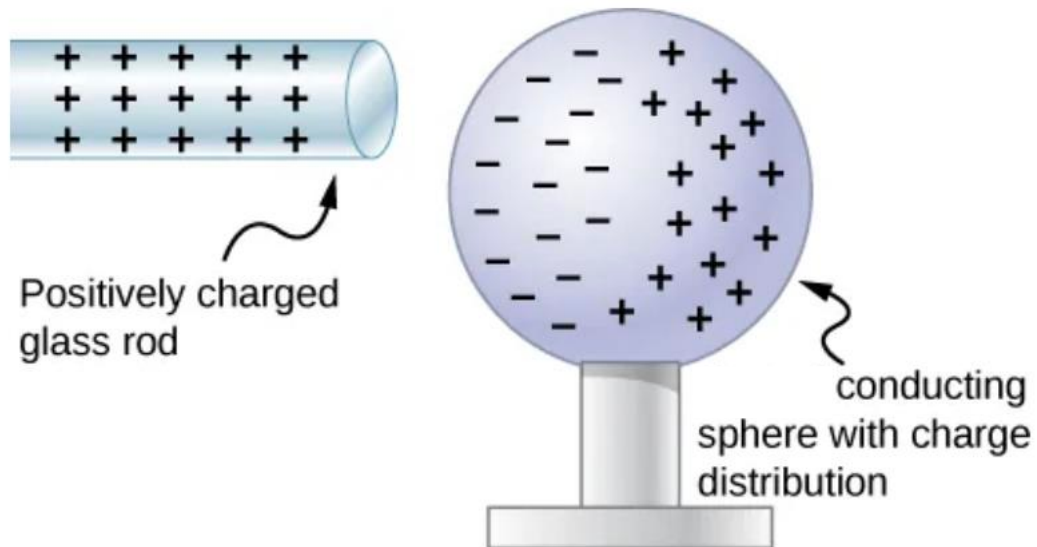
If the sphere was neutral before the rod was brought in, what is the total charge of the conducting sphere when the rod is near, as in the figure?



- A. Positive
- B. Negative
- C. Neutral
- D. None of the above

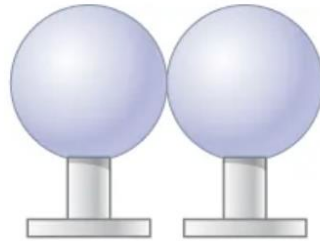
Polarization in Conductors

What kind of force will exist between the rod and the sphere?



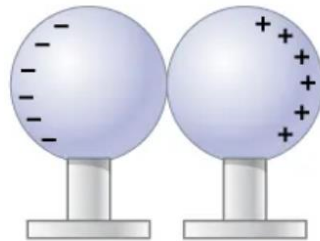
- A. Attractive
- B. Repulsive
- C. No force

What charge will be on each sphere when we take away the rod?



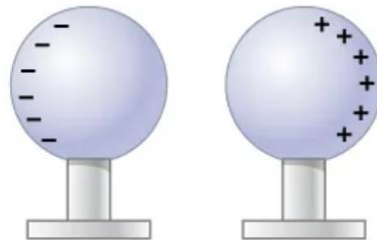
(a)

A charged rod...



... causes separation of charge

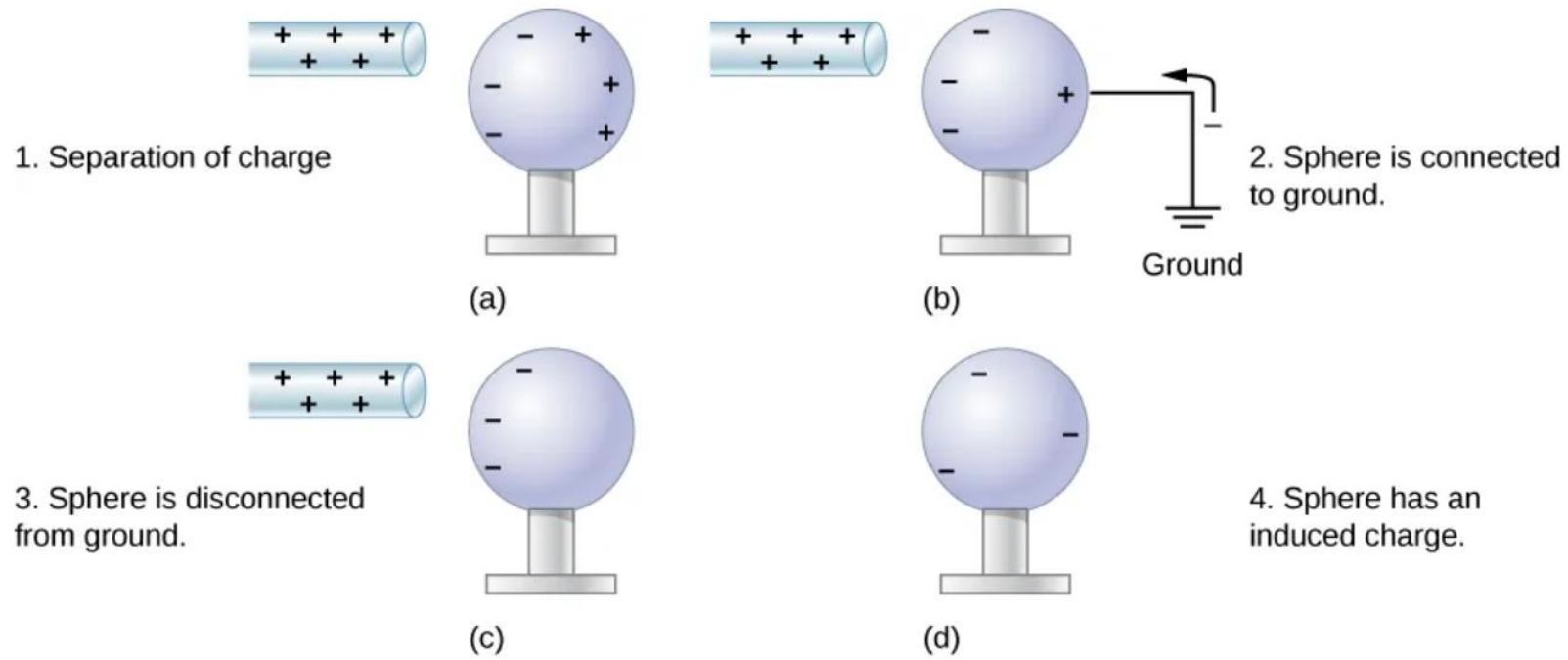
(b)



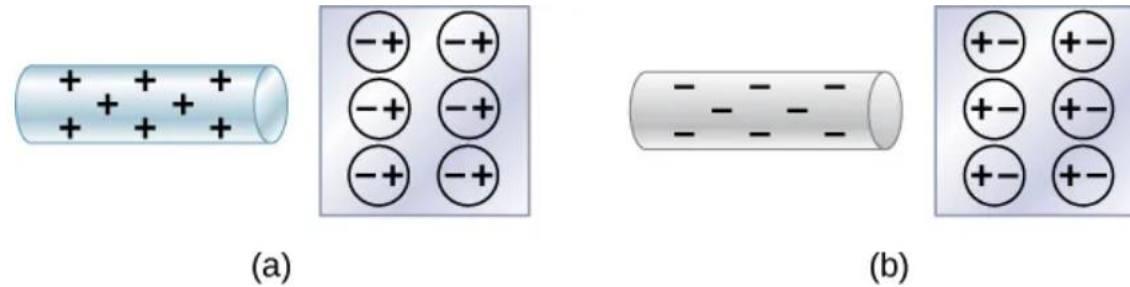
The spheres are separated.

(c)

- | | Q_L | Q_R |
|----|-------------------|-------|
| A. | + | - |
| B. | 0 | 0 |
| C. | - | + |
| D. | None of the above | |



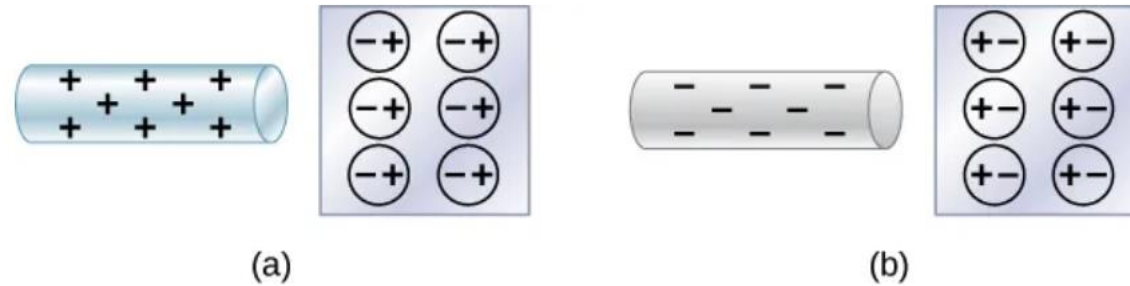
Polarization in inductors



- Electrons are attracted to the charged rod within the atom.
- Each atom becomes a tiny dipole.
- Net charge is still neutral, but there will be a force of attraction from the charge distribution.

Polarization in insulators

Can you charge an insulator by induction?



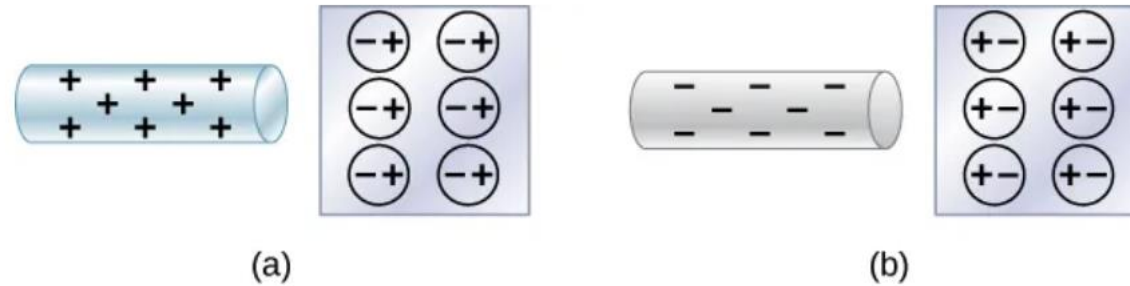
A. Yes

B. No

C. I don't know

Polarization in insulators

Can you charge an insulator by induction?



B. No! Charge can't flow in the insulator.