

# Electricity and Magnetism

- Physics 259 – L02
  - Lecture 2

# In-class activities

- **Purpose:** to help you develop problem solving skills for midterm and final exam
- **Activity:** problem with steps you need to take in order to solve it (showing your work); majority of the marks
- **Final answer:** MCQ (1 mark)
- **Exams:** no help with steps – MCQ only
- **Ask questions:** lecture TAs and instructor

Phys 259, Group activity 1, Winter 2017

Group #	Student	Last Name	First Name
	1		
	2		
	3		
	4		

(10 marks) Problem text will be here.

The questions below walk you through the steps to solve this problem. Please show all work in the boxes provided and then choose the correct answer.

1. (2 marks) Step 1

2. (3 marks) Step 2

3. (4 marks) Step 3

(1 mark for correct answer) Answer (please circle the correct one):

A) 3 units

B) y units

C) z units

D) q units

# In-class activities

- **Groups of 4** (assignment on Friday Jan 13, please sit next to your preferred peers, if known)
- Each group will be given a number to **self-enroll on D2L on Friday**
- Groups stay the **same** for the entire term
- Activity (30 min); submission via **group Dropbox**
- File should include **group number and names** of peers present that day
- Submit **PDF file** (please install the app on your phone/ tablet:  
<https://www.camscanner.com/>)
- Submission by the end class (+ 10 min grace period), **late submission = no grade**

# WileyPlus settings

- 4 attempts, 30% deduction after second attempt
- Settings are posted on D2L (folder: WileyPlus)

## GENERAL POLICY CONFIGURATIONS

### Score & Feedback ?

- ☐ Do not show students their scores or answer feedback until due date has passed
- ☒ Show students their scores and answer feedback after each attempt

### Question Attempts Allowed ?

4

After

after second attempt

reduce score by

30%

[How does Point Reduction work?](#)

## QUESTION ASSISTANCE

### Show Hint after

always visible

Reduce Score By

0%

[How does Point Reduction work?](#)

### Show Link to Text after

always visible

Reduce Score By

0%

### Show Entire Solution after (i.e: steps to final answer)

never

Reduce Score By

0%

### Show Answer Only after (i.e: final answer only)

after fourth attempt

Reduce Score By

0%

# Section 21.1



# Fundamental characteristics of particles

All fundamental particles can be classified according to two observable parameters: **mass and charge**.



This simplified model of the universe is incredibly effective at explaining a wide range of physical phenomena.

# Forces in nature

There are 4 fundamental forces in nature (that we know of):

1. Strong Nuclear Force: responsible for holding together protons and neutrons, as well as holding atomic nuclei together. Very short-range ( $\sim 10^{-15}$  m)
2. Weak Nuclear Force: Responsible for radioactive decay and fusion reactions in the sun. Very short-range ( $\sim 10^{-17}$  m)
3. Electromagnetic Force: Responsible for nearly everything we observe! Extremely important force to understand. Long range
4. Gravitational Force: Responsible for planetary orbits, holding together galaxies, maintaining an atmosphere. Long range

# What is an electric charge?

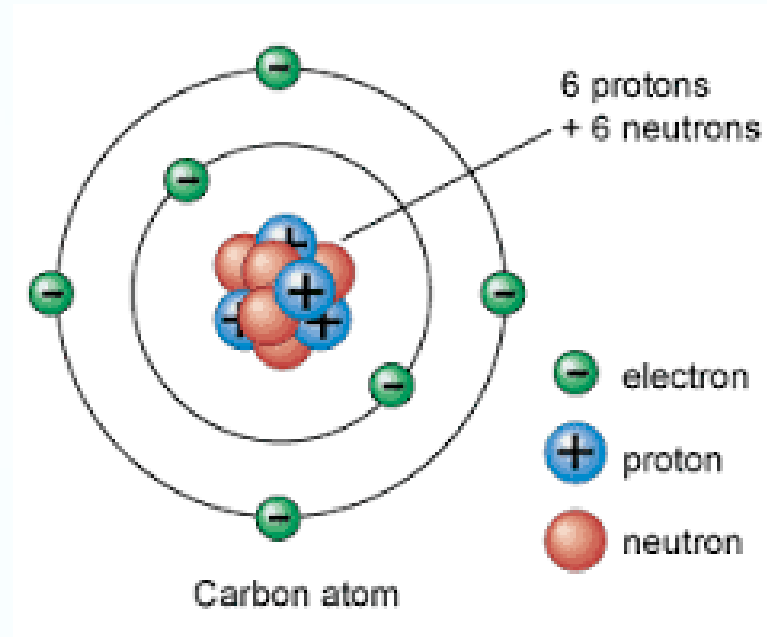




# What is an electric charge?

- An intrinsic property of particles: electrons (–) and protons (+)
- A quantity that determines the strength of the electric force between two objects.
- Can't be created or destroyed
- Can transfer from one object to another
- Like charges repel, opposites attract

# Atom



<https://goo.gl/BUVMm2>

If you could fill a 4L milk jug with material as dense as an atomic nucleus, it would have the mass of Mount Everest.

Almost all of the mass is contained in the nucleus, while almost all of the space is occupied by the electron cloud.

The diameter of a nucleus is much smaller than the diameter of atom, by a factor of about 23,000 (uranium) to about 145,000 (hydrogen).

## Electric charge is *quantized*

Charge always comes in some integral multiple of some fundamental charge  $e$ , which is the charge of electron.

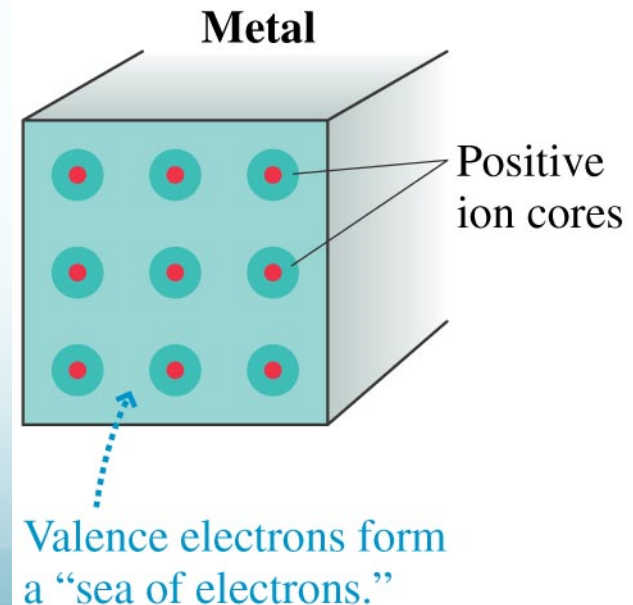
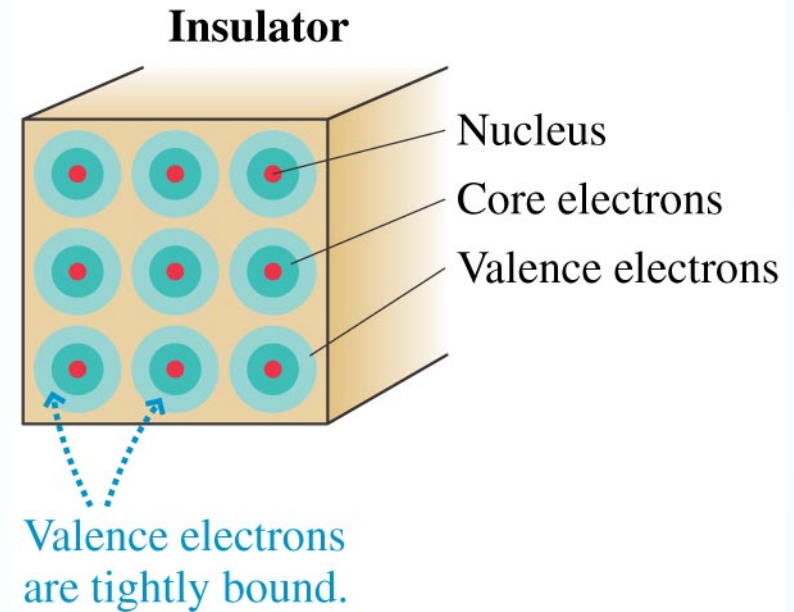
Electric charge comes in discrete packets.

Light comes in discrete packets too, photons.

$$E = h\nu$$

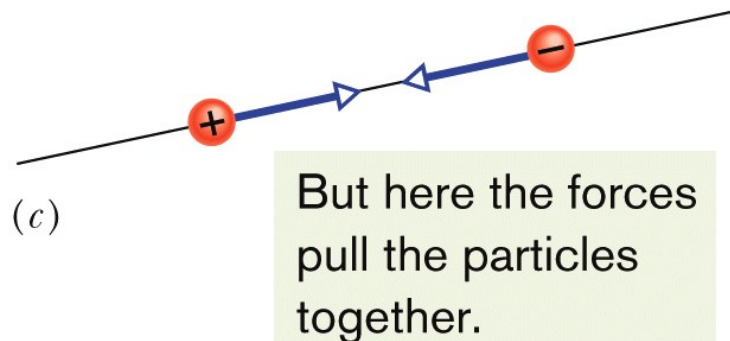
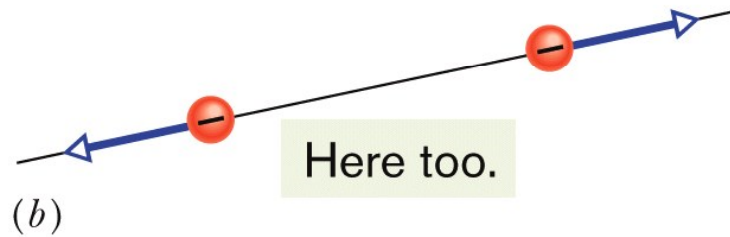
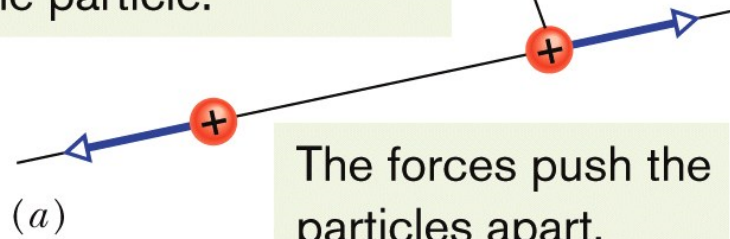
**Insulators** do not conduct electricity, because the electrons are **not** free to move.

**Conductors** do conduct electricity, because the electrons **are** free to move.



# Two kinds of charges:

Always draw the force vector with the tail on the particle.



# Balloon demo

(Yay! Everyone loves balloons!)

What is going on in the two cases?

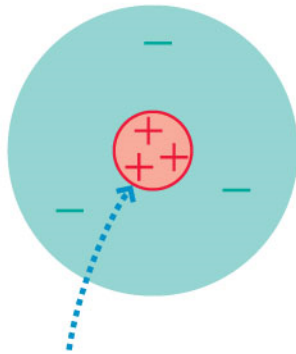
**Balloon on hair:**

Balloon and hair rub together → oppositely charged → attraction

**Balloon on wall:**

is the wall charged?

# Charge Polarization

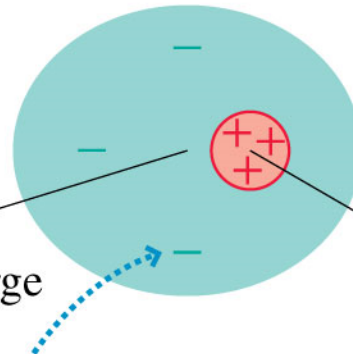


In an isolated atom, the electron cloud is centered on the nucleus.

This external charge polarizes the atom.



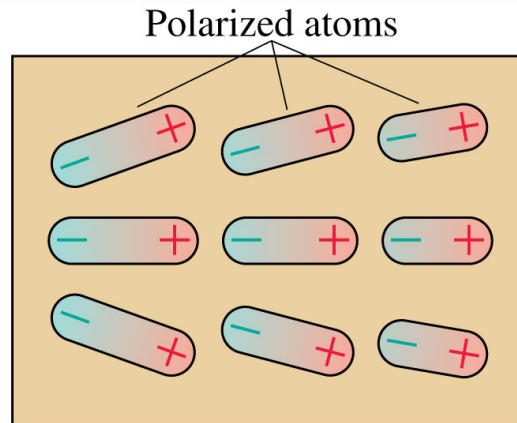
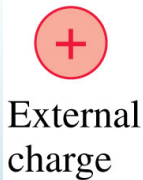
Center of negative charge



Center of positive charge

The polarized atom is an electric dipole.

Balloon

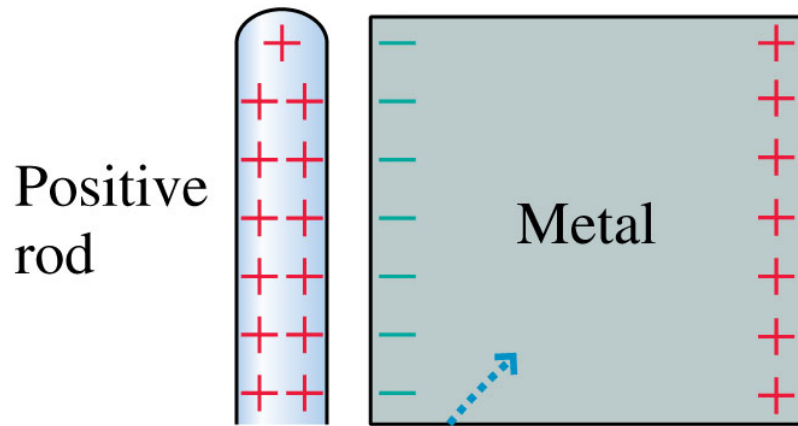


Insulator



Wall

# What happens with conductors?



Negatively charged valence electrons inside the conductor are able to freely move around. The positively charged atomic cores are fixed in place.

A deficit of electrons—a net positive charge—is created on the far surface.

The metal's net charge is still zero, but it has been *polarized* by the charged rod.

Free electrons are attracted to the positively charged rod, inducing a polarization.



**Both neutral: no force**

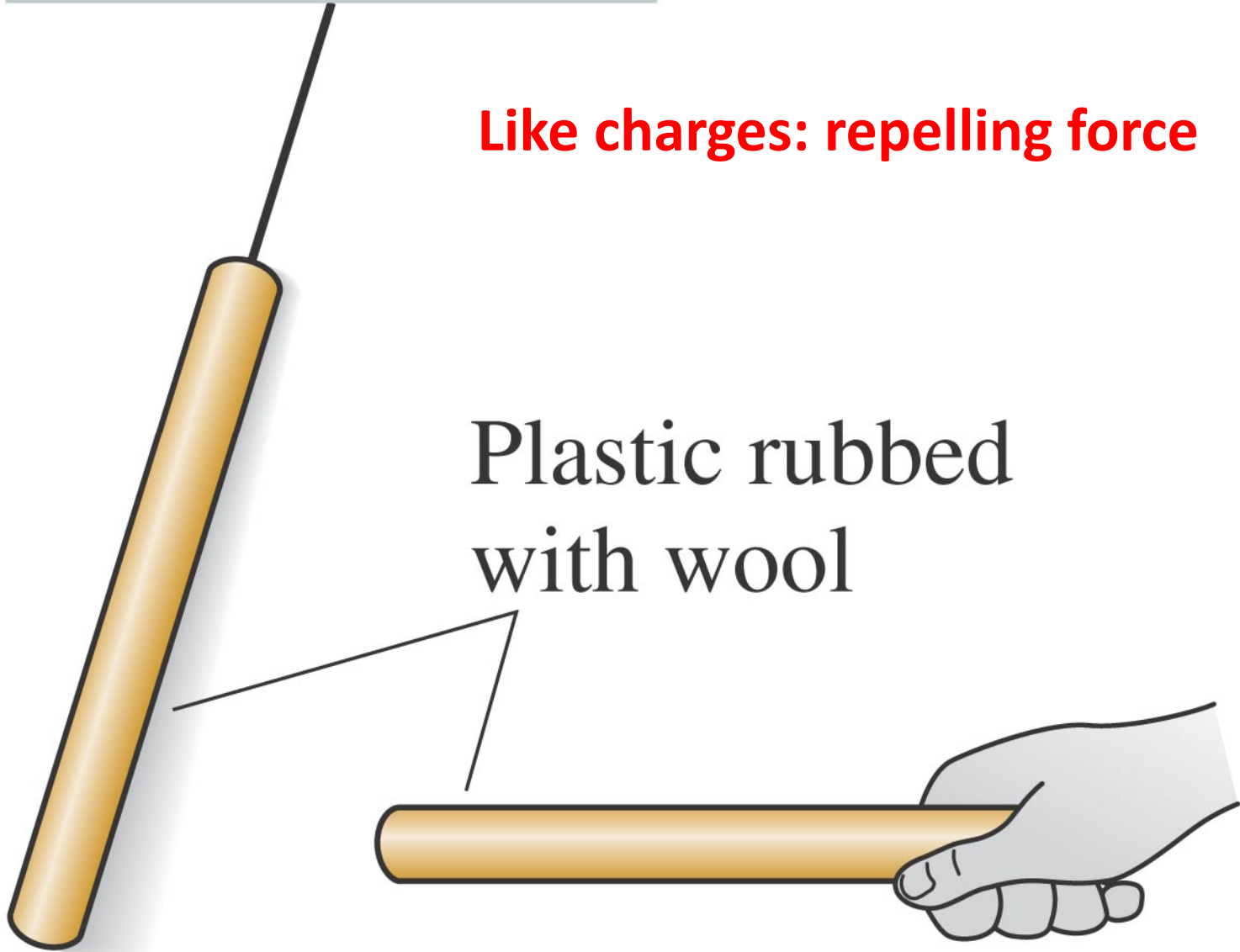
Rods that haven't  
been rubbed

Plastic

Plastic

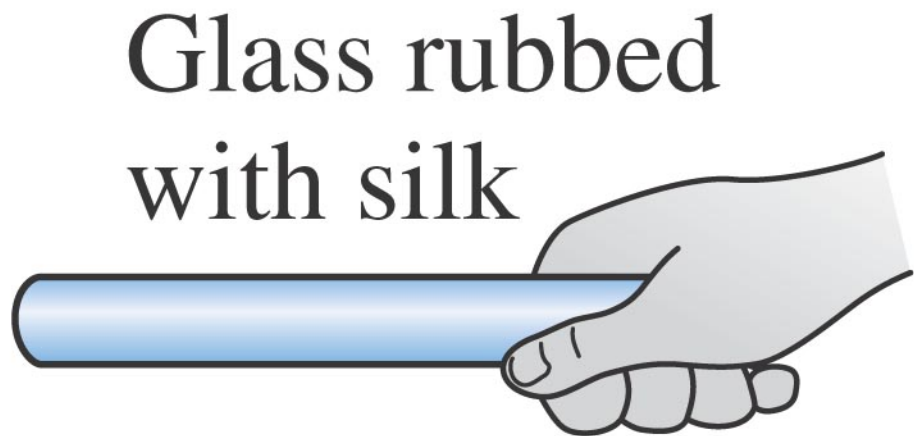
**Like charges: repelling force**

Plastic rubbed  
with wool



**Opposite charges: attracting force**

Plastic  
rubbed  
with  
wool



# TopHat Question



Course name: PHYS259W2017L02

Registration Code: 655005

Which of the following terms is used to describe a material that does not allow electrons to easily move through it?

- a) Conductor
- b) Insulator
- c) Inductor

This section we talked about:

Chapter 21.1

*See you on Thursday*

