DeAnza College

Electricity and Magnetism
Overview of Course
Charge and Conduction

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De Anza College

Sept 22, 2015

Overview of the Course

Topics

- charge
- static electric interactions
- electric fields
- electric potential
- capacitance
- current, resistance, circuits
- magnetic fields, induction
- alternating currents
- Maxwell's equations

Overview of the Course

Should I take this course?

You should if:

- You enjoy physics and other technical subjects.
- You are curious about how nature works.
- You will spend time on your own thinking through concepts and problems.

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You not should if:

- You just want an easy A.
- You just want to memorize answers without understanding them.
- You will not make time to work on problems outside of class.

Overview of the Course

Book

- Fundamentals of Physics Extended, 9th Edition, Halliday, Resnick, and Walker

We will cover chapters 21–33 of this textbook.

Other Books

- Physics: Principles with Applications, Giancoli (no calculus)
- Physics: A Strategic Approach, Knight (calculus with clear explanation)

Useful Survival Trick

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When you get stuck, use a search engine.

Other Resources

Resources for when you have questions

- Me. You can email me, ask me before or after class, or come to my office hour.
- Each other. Work together! It will improve your understanding.
- The Math & Science Tutorial Center.

Where to look for course materials

- Course Studio.
- My website on the De Anza Physics page.

Overview of the Course

Evaluation

- Midterm and Final exam.
- Weekly quizzes.
- Labs.

Assignments

- Uncollected homework problems from the textbook. (You still need to do them.)
- A few collected homework worksheets.
- Read the textbook.

Overview of the Course

Evaluation

quizzes & worksheets	30%
midterm	20%
final	30%
labs	20%

Projected Grading Scheme:

$$\begin{aligned} 88\% \to 100\% &= A \\ 76\% \to 87\% &= B \\ 65\% \to 75\% &= C \\ 54\% \to 64\% &= D \\ 0\% \to 53\% &= F \end{aligned}$$

Overview of the Course

Note about presentation of work

- For each problem make sure your method is clear.
- If there is an equation or principle you are using, write it out at the start of your solution.
- Underline, box, highlight, or unambiguously emphasize the answer.
- If the reasoning is not clear, the answer is not correct.
- Give your answers to a reasonable number of significant figures.

Overview of the Course

Note about collected assignments

- If you cannot come to class on a due date, email me the assignment and bring the hard copy to the next class.

- If you are ill, or will have a problem handing in an assignment on time, come talk to me **before** the due date.

Electricity and Magnetism

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What changed?

Electricity and Magnetism

Electricity isn't new: Ancient philosophers, including Greek philosophers, were aware of both electric and magnetic phenomena.

It was not until 1820 that Hans Christian Ørsted realized by accident that electricity and magnetism were related.

Electricity and Magnetism

Goals:

- know how to use EM theory to solve problems
- understanding EM principles and how they apply to technology
- have a feeling for the scope of EM theory

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Any physical object or group of objects about which we would like to make quantitative predictions.

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Model

A simplified description of a system and its interactions that includes only what is necessary to make predictions.

Overview

- electric charge
- conductors
- insulators
- induced charge
- Force from a point charge
- Force from many charges

Electric Charge

Charge is an intrinsic property of subatomic particles.

Charge can be positive or negative.

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The unit for charge is the Coulomb, written with the symbol C.

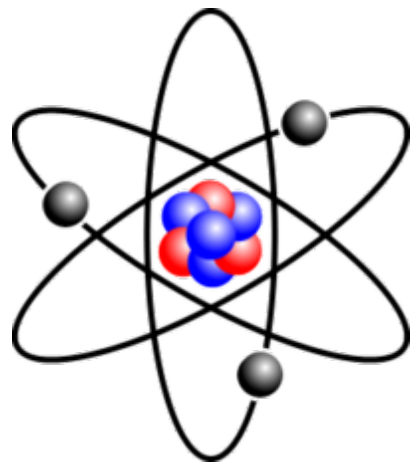
Charges of some particles

Atoms are composed of electrons and a nucleus.

Electrons are negatively charged.

Nuclei have a positive charge:

- protons have positive charge
- neutrons are neutrally charged



[1] Figure from Wikipedia.

Electric Charge on larger objects

Before there was any knowledge of atoms, charge was imagined as a kind of continuous fluid.

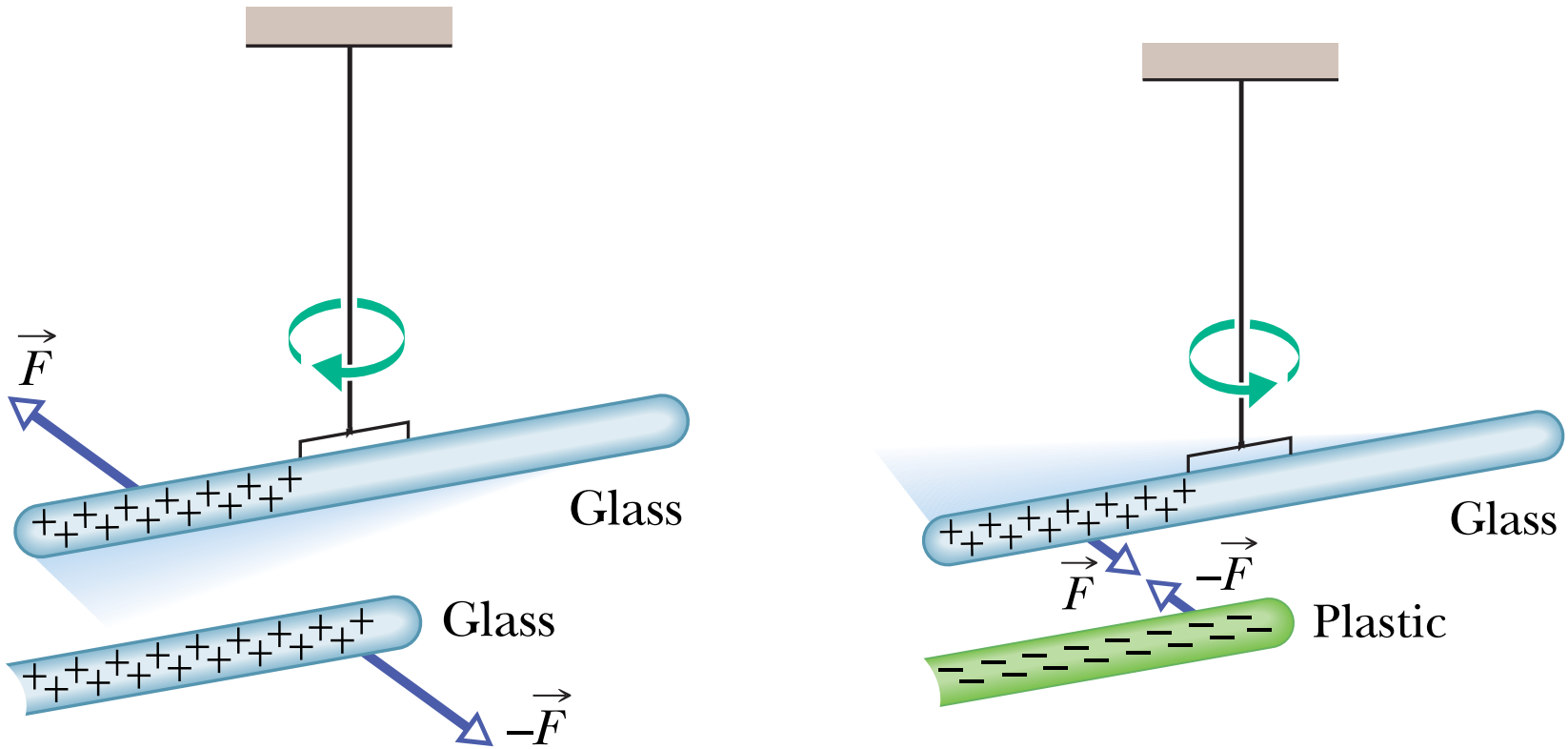
A large scale effect: In dry weather, it is easy to get a shock from static electricity.

This is due to a charge imbalance.

Charge on larger objects

Most large objects around us have (approximately) zero net charge.

Objects can become charged when rubbed against one another.



[1] Diagrams from Halliday, Resnick, Walker, 9th ed.

Electrostatic force

Charged objects exert a force on one another.

Charges with the **same** electrical sign **repel** each other.

Charges with **opposite** electrical signs **attract** each other.

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Charged objects can also attract neutral objects by charge induction or polarization.

Some Vocabulary

electrically neutral

An object is electrically neutral if its net charge is zero.

electrically isolated

An object is electrically isolated if it cannot exchange charge with its surroundings.

Conductors and Insulators

Some materials allow charges to flow through them easily, some do not.

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Some materials allow charges to flow through them easily, some do not.

Conductors

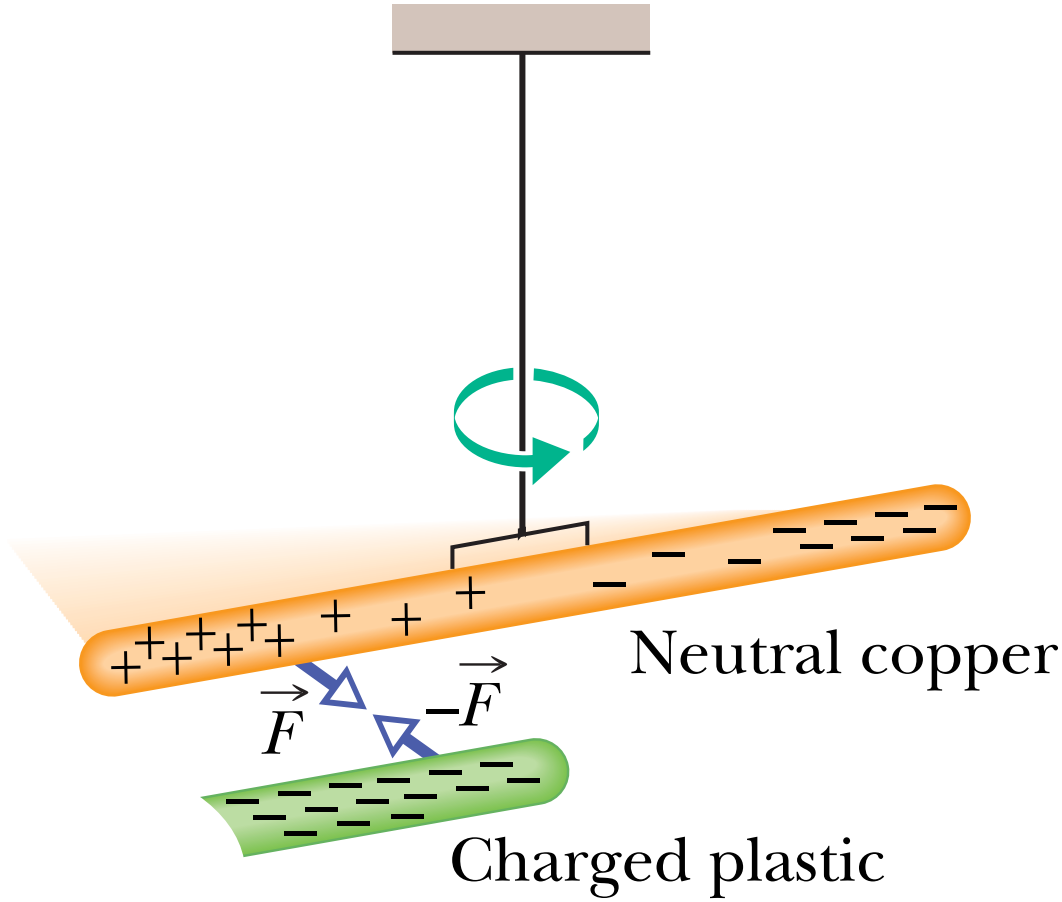
materials through which charge can move readily

Insulators

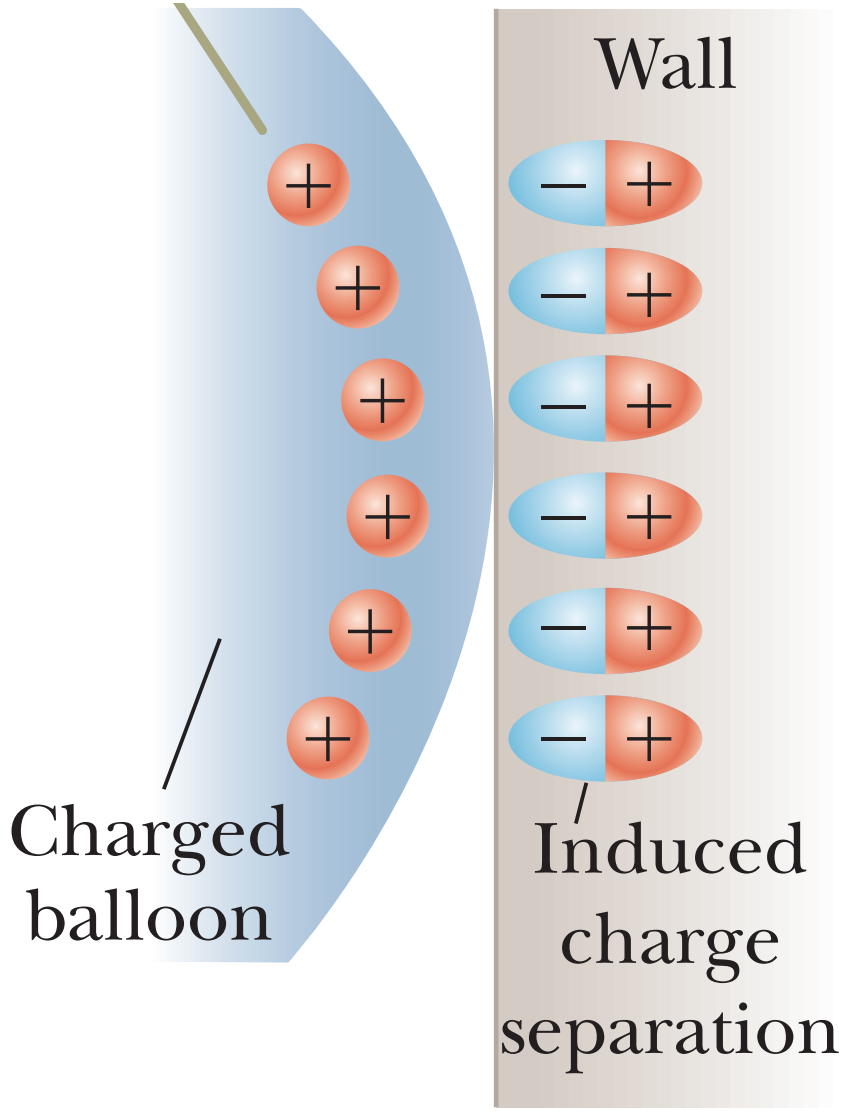
(also called nonconductors) are materials that charge cannot move through freely

Induced Charge

If a conductor is brought close to a charged object, positive and negative charges in the conductor start to separate and we say a charge is **induced** on the conductor.



Induced Charge Polarization



Course Tool

Quiz Socket

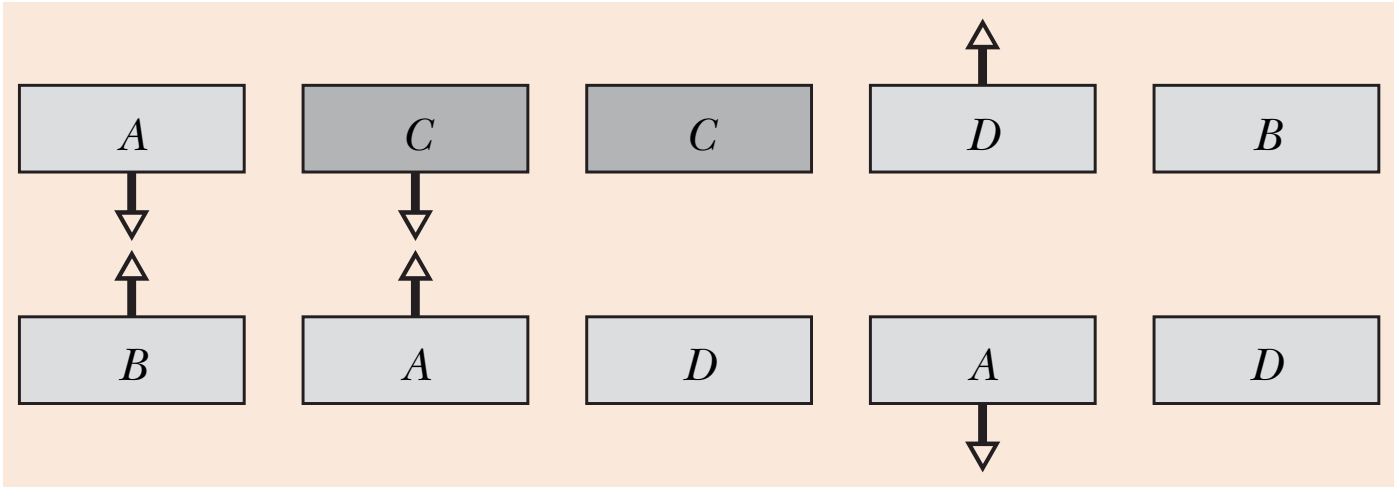
http://www.quizsocket.com

- Allows me to ask multiple choice questions or do surveys, and get real-time feedback.
- You remain anonymous.
- You need a device connected to the internet.

Load the webpage (http://www.quizsocket.com) and enter the quiz id.

Question

A, B, and D are charged pieces of plastic. C is an electrically neutral copper plate.



Plates C and D

(A) attract each other

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[1] Page 564, Halliday, Resnick, Walker, 9th ed.

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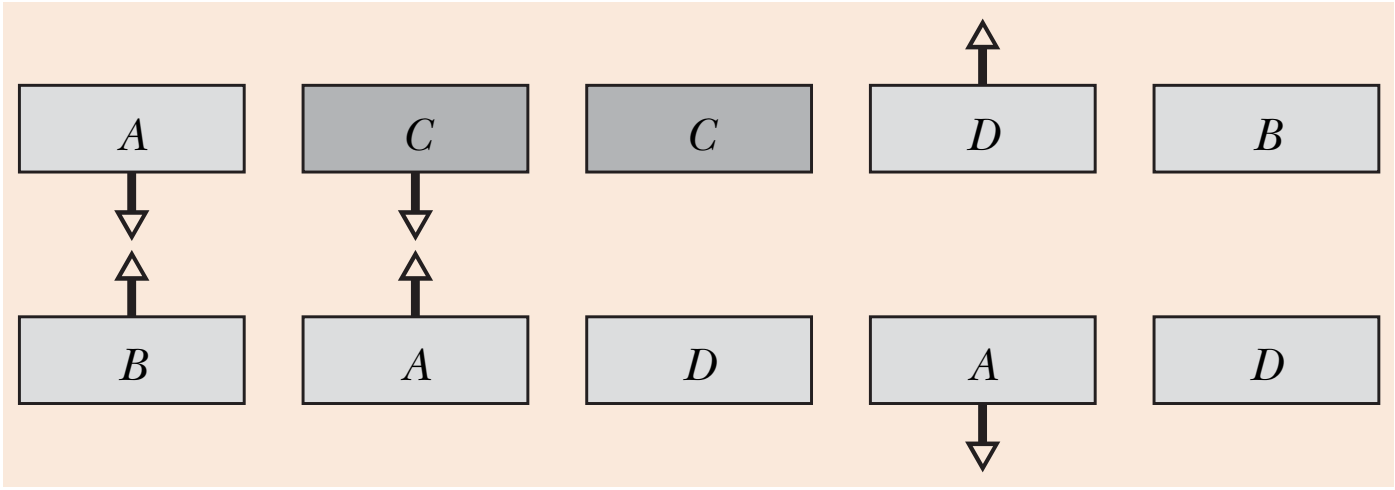

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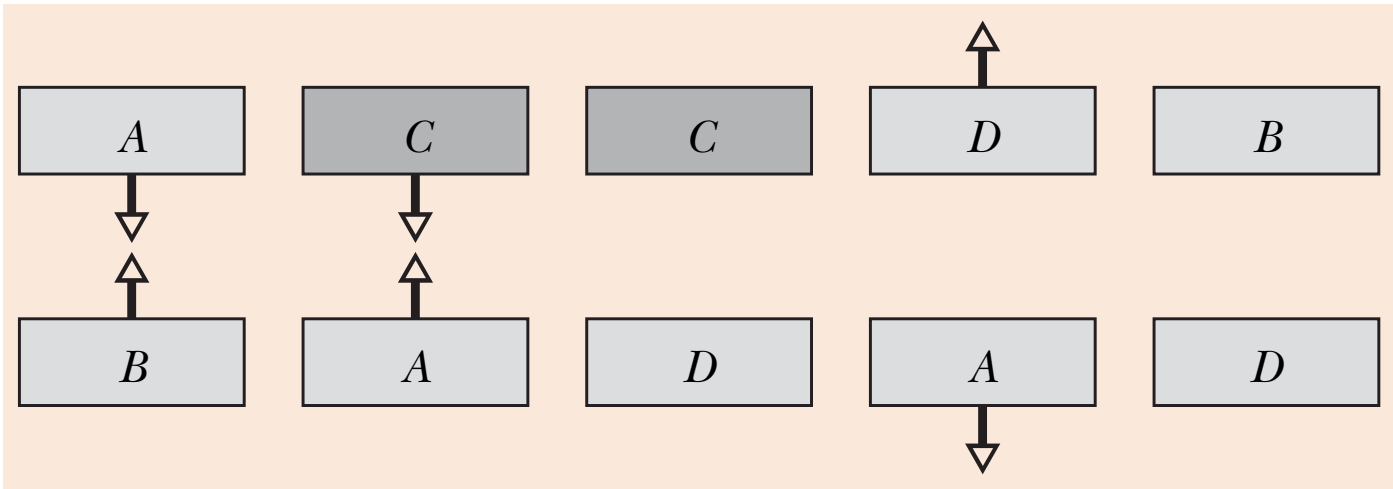

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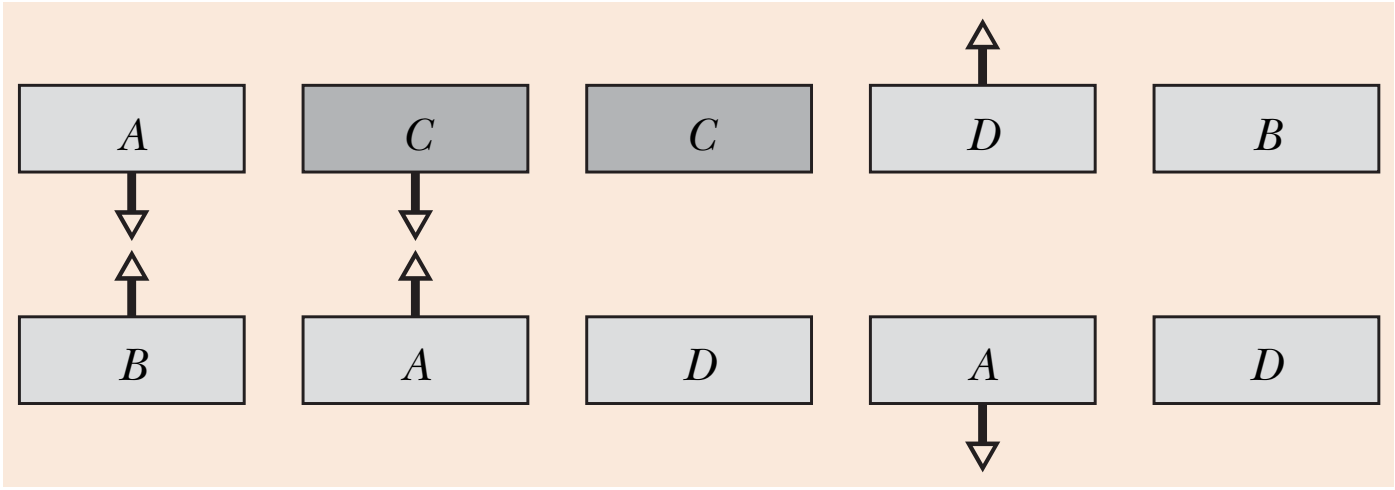

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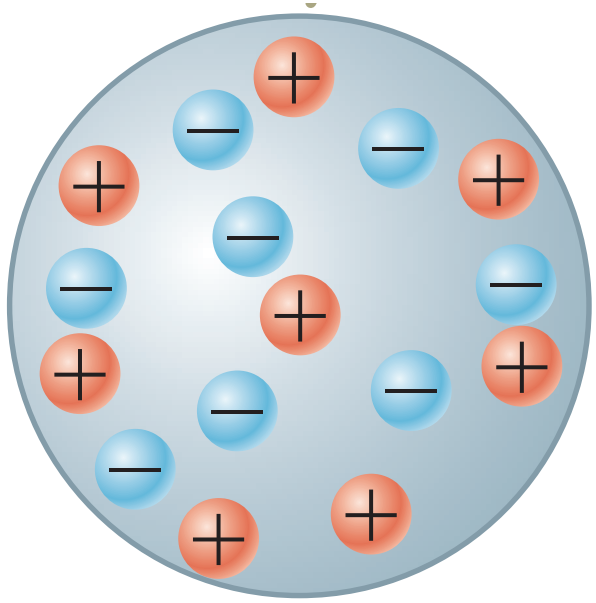
Charging by Induction



A conductor is initially neutrally charged.

[0]Figures from Serway & Jewett, 9th ed.

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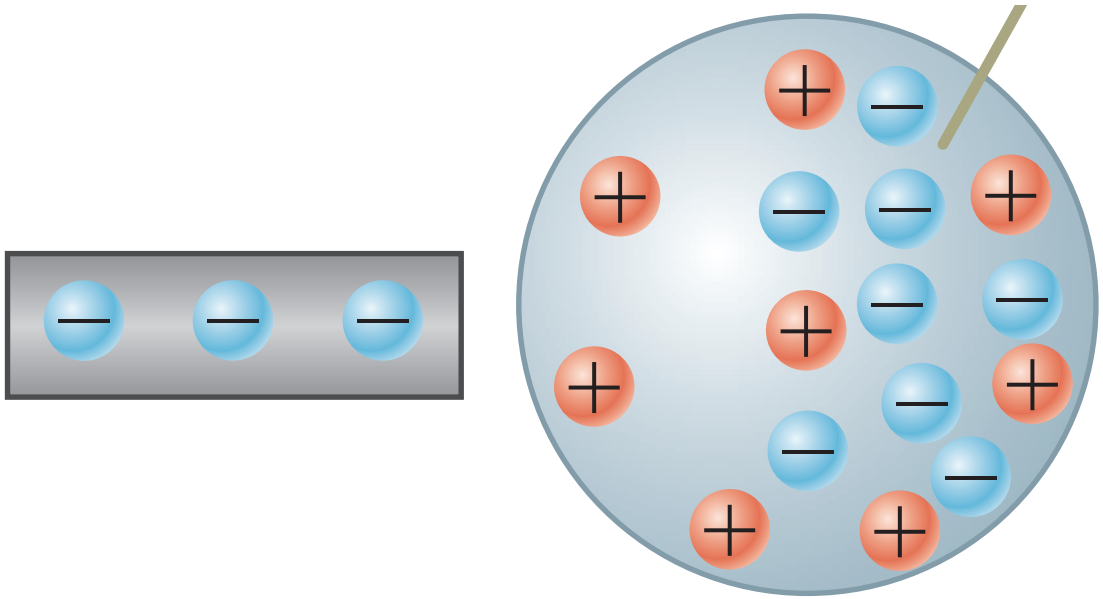

A (negatively) charged object is brought close, polarizing the conductor.

[0]Figures from Serway & Jewett, 9th ed.

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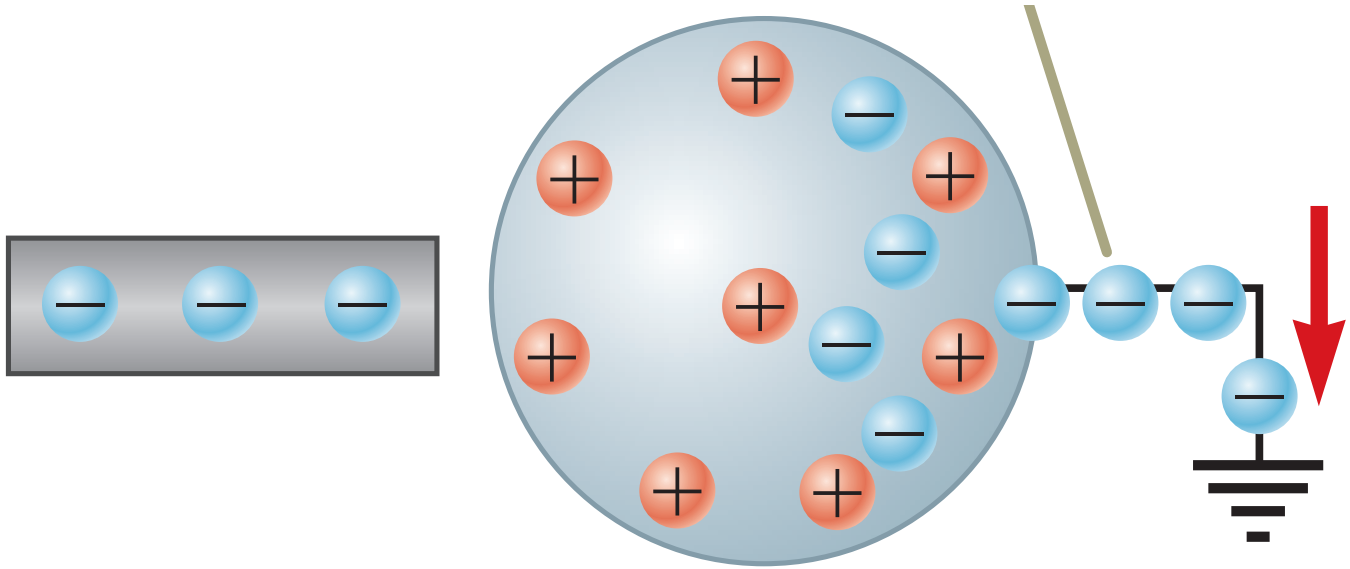

Excess (negative) charge on the far side is drawn off the conductor by grounding it.

[0]Figures from Serway & Jewett, 9th ed.

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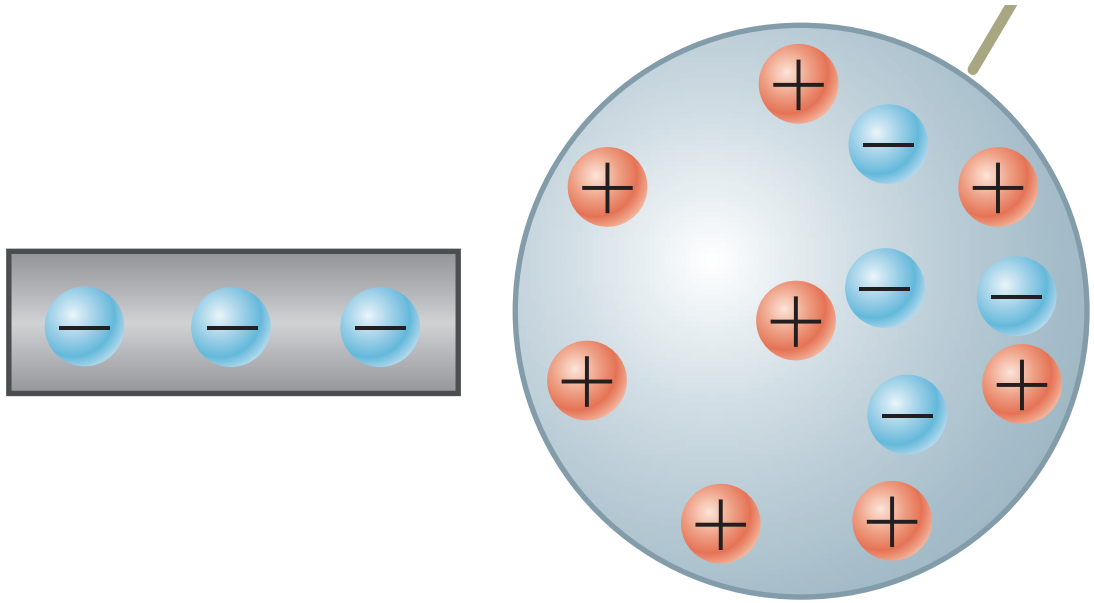
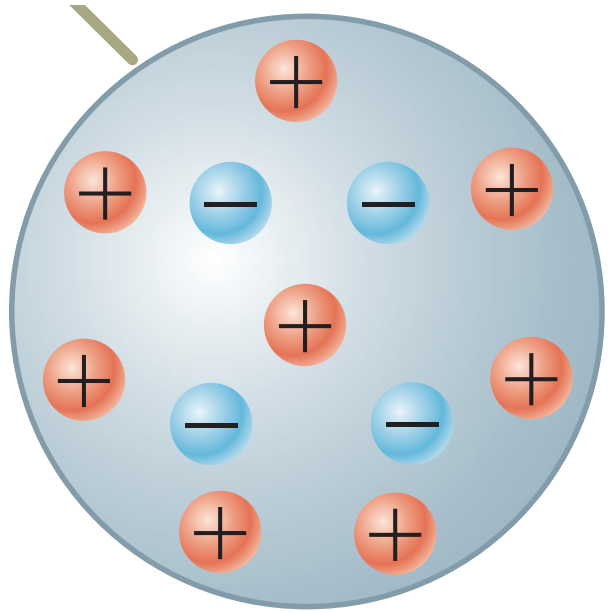


The conductor is isolated again.

[0]Figures from Serway & Jewett, 9th ed.

Charging by Induction



The conductor is now (positively) charged.

[0]Figures from Serway & Jewett, 9th ed.

Summary

- content of the course
- charge
- conductors and insulators
- Force from a point charge
- Force from many charges

Homework

- Get the textbook: Fundamentals of Physics Extended, 9th Edition, Halliday, Resnick, and Walker
- Read the Lab instructions for Thursday.
- Read Ch 21.
- Do the worksheet at http://www.physicsclassroom.com/getattachment/curriculum/estatics/static2.pdf