DeAnza College

Electricity and Magnetism
Overview of Course
Charge and Conduction

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De Anza College

Jan 8, 2018

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: Textbook Topics

Book

- Physics for Scientists and Engineers, 9th Edition, Serway & Jewett

What we will cover

- Part 4: Chapters 23-34 of Serway & Jewett, pretty much in order.
- Just a little relativity (see ch 39) for intuition.

Overview of the Course

Other Books

- Fundamentals of Physics Extended, Halliday, Resnick, and Walker
- Physics for Scientists and Engineers, Knight
- Feynman Lectures on Physics, Vol 2
- Classical Electrodynamics, Jackson

Homework

- Collected homework assignments.
- Uncollected homework problems from the textbook. (You still need to do them.)
- Read the textbook.

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Evaluation

- Three tests and a final exam.
- Four collected homework assignments.
- Quizzes.
- Labs.

Overview of the Course

Evaluation

- Quizzes (8%)
- 3 Tests, equally weighted (26%)
- Final exam (30%)
- 4 collected HWs (16%)
- Labs (20%)

Overview of the Course

Evaluation

Projected Grading Scheme:

$$
\begin{aligned}
95\% \to 100\% &= A+ \\
88\% \to 94\% &= A \\
85\% \to 87\% &= A- \\
82\% \to 84\% &= B+ \\
73\% \to 81\% &= B \\
70\% \to 72\% &= B- \\
67\% \to 69\% &= C+ \\
58\% \to 66\% &= C \\
46\% \to 57\% &= D \\
0\% \to 45\% &= F
\end{aligned}
$$

Overview of the Course

Full Disclosure

Electricity and magnetism is very interesting, however:

- It can be very abstract.
- It uses vector calculus heavily.
- You will need to spend time on your own thinking through concepts and reading.
- You will need to make time to work on problems outside of class and discuss with others.

Useful Survival Trick

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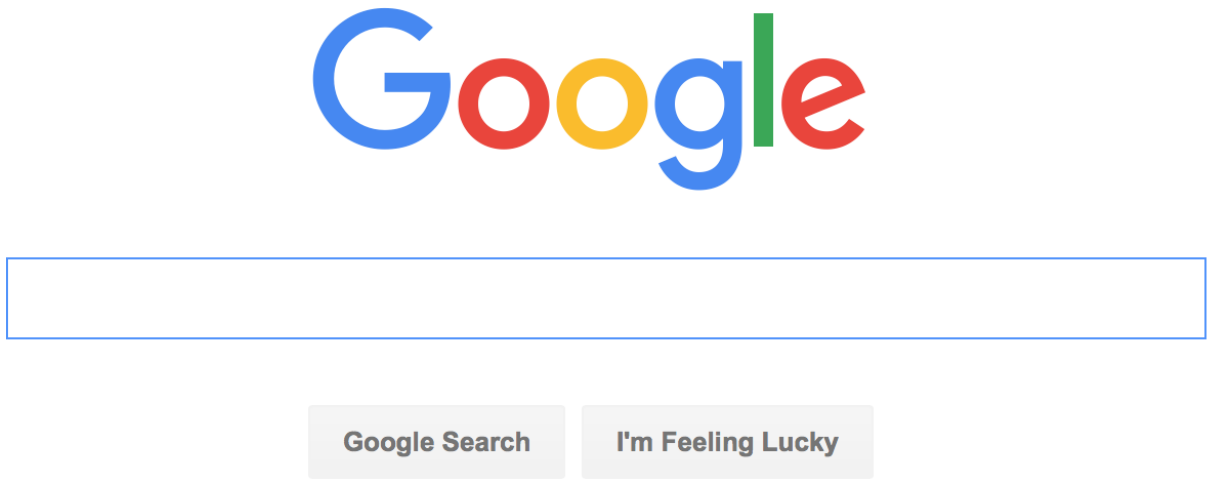

When you get stuck, use a search engine.

Other Resources

Resources for when you have questions

- Me. You can email me, ask me before or after class, or come to my office hours. **Wed 11:30-12:30pm**, **Fri 10:30-11:30am**

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- The Math & Science Tutorial Center.

Where to look for course materials

- My website on the De Anza Physics page. **http://nebula2.deanza.edu/~lanasheridan/index.html**
- Course Studio (as a back up).

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.

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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.

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However, it seemed to be a set of rules that did not behave as expected.

Kelvin:

"The beauty and clearness of the dynamical theory, which asserts heat and light to be modes of motion, is at present obscured by two clouds. I. The first came into existence with the undulatory theory of light, and was dealt with by Fresnel and Dr Thomas Young; it involved the question, **How could the earth move through an elastic solid, such as essentially is the luminiferous ether?** II. The second is the Maxwell-Boltzmann doctrine regarding the partition of energy."

Electricity and Magnetism

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The final result was even more surprising:
$\rightarrow$ we gave up absolute space and time instead.

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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- How does a solar cell (that converts solar energy into electrical energy) work?
- What is light? Where does it come from?

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Model

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

Electric Charge

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

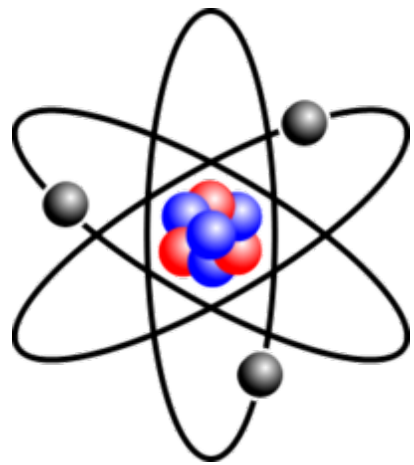
Charges of some particles

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.

Fundamental Unit of Charge

The smallest unit of charge is called e.

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

The charge on an electron is $-e$.

The charge on a proton is $+e$.

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.

Electrostatic force

Charged objects exert a force on one another.

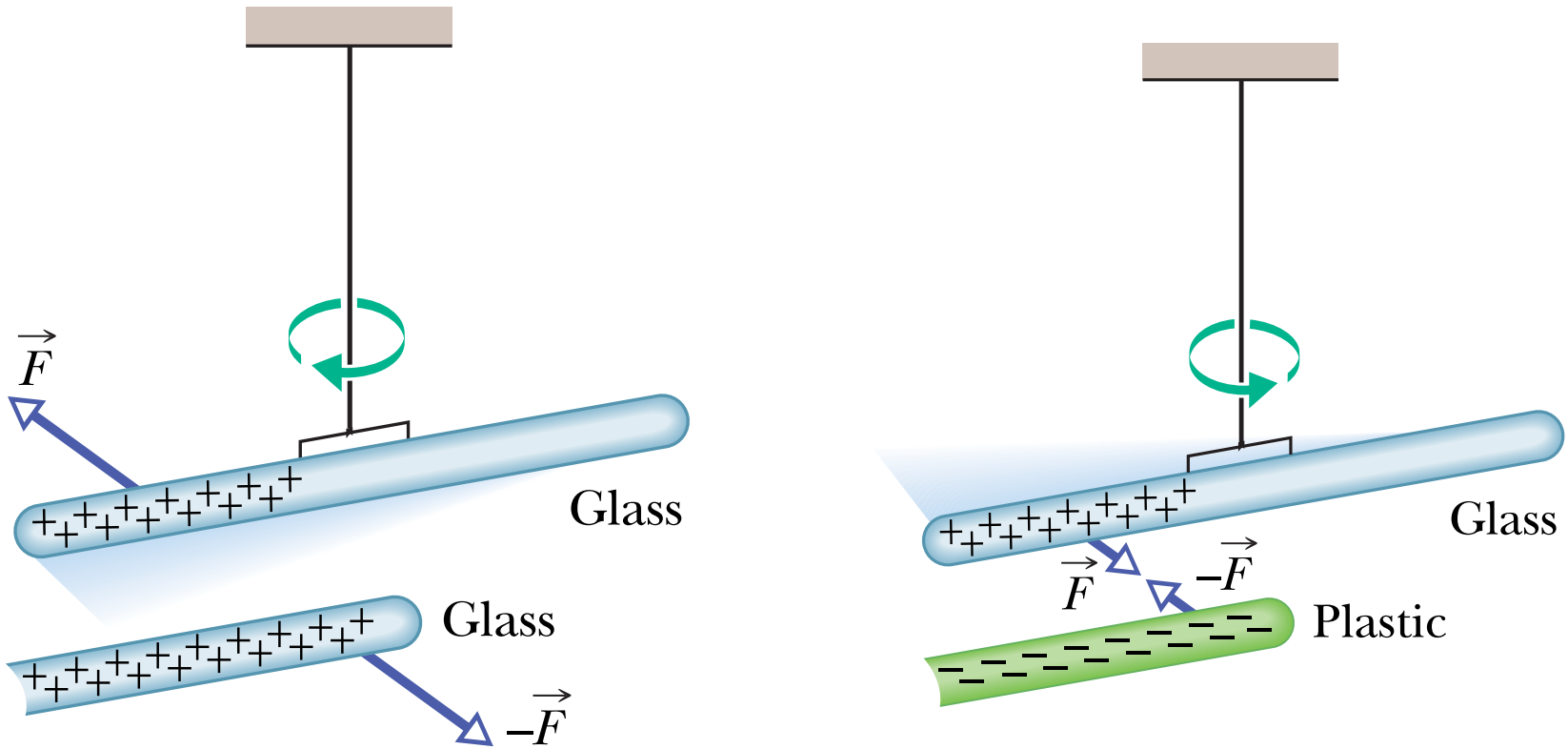
Charges with the **same** electrical sign **repel** each other.

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

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.

Summary

- content of the course
- charge

Homework

- Get the textbook: Physics for Scientists and Engineers, 9th Edition, Serway & Jewett
- Read Ch 23.
- Ch 23, onward from page 716. Objective Qs: 2; Conceptual Qs: 5; Probs: 1