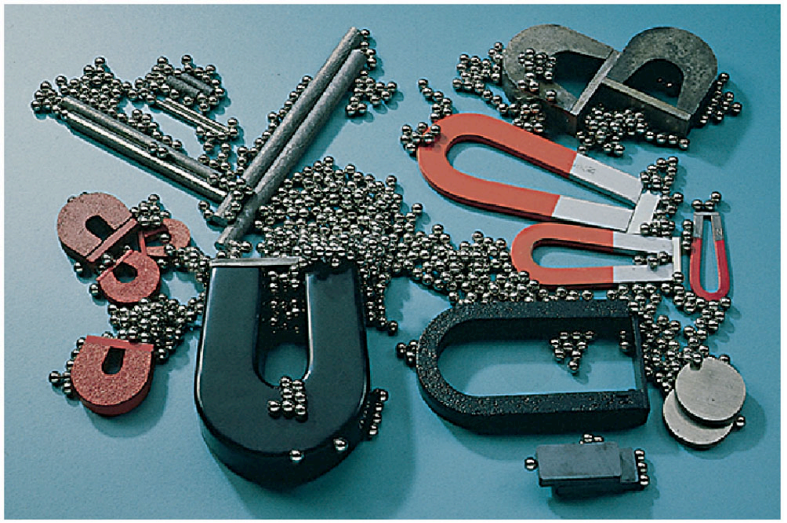
Physics 1B: Electricity & Magnetism

Dr. Alex Markowitz

(UCSD/CASS)

Summer 2010 (session I)



Administrative Info.

Lectures: M, Tu, W, Th 09:30-10:50 a.m., 4080-A York Hall

TA: Marcel Neeleman

Problem Sessions: Every Wed, 3-5 p.m., 2301 APM

Phys 1B-LAB -- completely separate course/grading

Prerequisites: Physics 1A & 1AL. Prior or concurrent enrollment in Math 10C, 10D or 20C

Course website:
http://physics.ucsd.edu/students/courses/summer2010/session1/physics1b/

Administrative Info.

Textbook: Serway & Faughan, College Physics, 7th ed.

Make sure your version has Ch. 21! If not, download it from the course website

My Office Hours: Mon 11:30-12:30 & Wed 1:00-2:00

My office Location: 412 SERF Bldg.

Marcel's office hours: Tu 12:30-1:30 & Wed 11-12

Marcel's office: 334 SERF Building

Office Location

APM

Science & Engineering Research Facility,

Offices #412/334

More admin. stuff

Grading:

QUIZZES (4 quizzes, one every Thursday): 63%
(lowest quiz grade =9%; other 3 = 18% each)

FINAL EXAM 37%

Final Exam: Friday, July 30, 08:00-11:00, 222 Center Hall

Bring your own scantron forms (X-101864-PAR) and #2 pencils!

Calculators: Bring ‘em, use ‘em

HOMEWORK -- Will not be collected/graded, but are the best way to practice for the quizzes/final.

Physics Tutorial Center will be staffed: 2702 Mayer Hall Addition, days/hours of operation TBD

More admin. stuff

If you're convinced your grade is incorrect, you may submit a request (WRITTEN HARDCOPY) detailing why your grade should be adjusted. Appeals must be received by the course instructor IN WRITING WITHIN 48 HOURS (excl. weekends) after the corresponding quiz/final grade is posted on the web. Frivolous appeals (those that lack basis) will be discarded.

ACADEMIC DISHONESTY: Please read the "UC Policy on Integrity of Scholarship" in the UCSD General Catalog. Cheating, including knowingly allowing a peer to copy your quizzes or tests, will result in an F in this course and referral to the Dean for disciplinary action. See
http://research.ucsd.edu/ethics/ucsd_policy.html
http://www.ucsd.edu/catalog/front/AcadRegu.html

More admin. stuff

Deadlines:
Last day to add a class: Friday, July 2
Last day to drop a class without a W and change grade option: Friday, July 9
Last day to drop a class WITH a W but without an F: Tuesday, July 27

Some recommendations

Keep a running list of equations (a ‘toolbox’)

Summer Session courses proceed twice as fast as Fall/Winter/Spring Qrtr courses!!! Study twice as hard!

Commit to studying and reviewing notes consistently -- Do not wait until the night before an exam (cramming never helps)

Online notes are meant to augment, not be a substitute for, attending lectures and problem sessions

All quizzes/exams are cumulative.

General overview of course:

15: Charges and Electric fields

16: electric potential, electrical energy

17: currents (moving charges) & resistance

18: simple circuits, time-dependent circuits

19: Magnets, magnetism, magnetic forces

20: Induced currents from magnetism

21: Alternating-current circuits; electromagnetic radiation

Why is E+M important?

In this course, applications covered include:

Electric Motors and AC generators; Power Line Transmission & Distribution; Household Circuits; Batteries

Magnets & Magnetism: Electromagnets, Computer Drives & Data Storage, Planetary Magnetic Fields

Medical Diagnostic Imaging (X-rays & MRIs)

Medical Devices (Defibrillators)

EM Radiation (radio, TV, cell phones, visible light)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Daniel Cichon
Chat (2)

Ch. 15: Electric Forces & Electric Fields

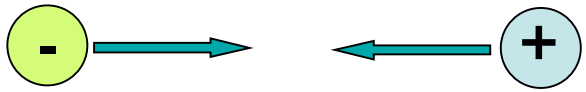
Properties of electric charges & how they interact with each other -- on both macroscopic and microscopic scales

Electrical Charges

Two kinds of charges: positive & negative

Like charges repel

Unlike charges attract



Electrical Charges

Charge is a quantized quantity ("e")

Proton: $e = +1.6 \times 10^{-19}$ C  $m_p = 1.67 \times 10^{-27}$ kg

Electron: $e = -1.6 \times 10^{-19}$ C  $m_e = 9.11 \times 10^{-31}$ kg

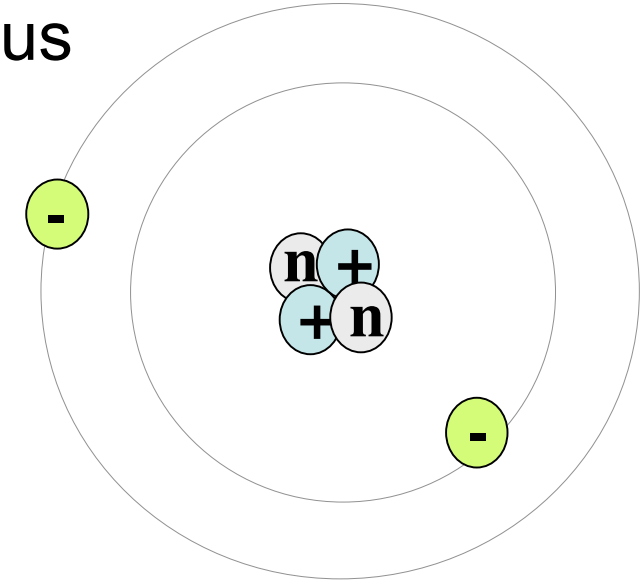
Units = Coulomb

An object may have a charge of 0, ±1e, ±2e, ±3e,…
("oil-drop" experiments by Millikan, ch. 15.7)

Total amount charge is conserved in any interaction

Nature of Matter

Review: Atoms contain nuclei with protons and neutrons; e^-'s orbit around nucleus



Most matter is neutral: equal numbers of +, – charges (sum of all charges is zero)

Charge transfer is usually due to movement of electrons

Insulators & Conductors

Insulators: do not conduct charges: glass, rubber, paper, plastic

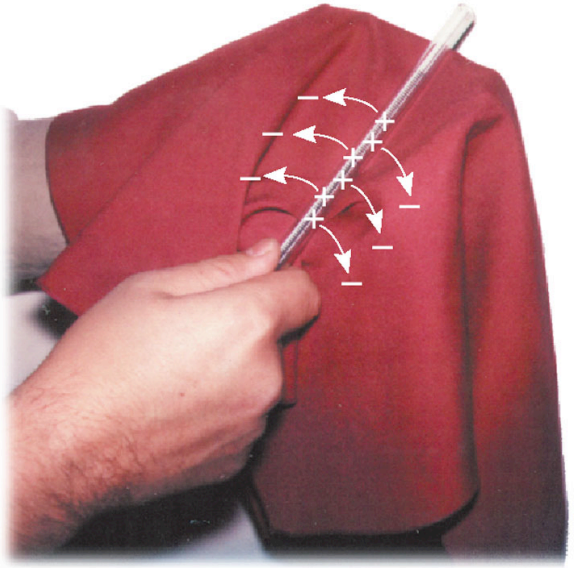
Conductors: Charges can move freely. Most metals. Density of charge carriers in Cu: $10^{29}/m^3$

Semi-conductors: intermediate conduction properties -- silicon, germanium. Density of charge carriers in Si: $10^{16}/m^3$

Charging by Rubbing

Examples: Glass + silk;
Rubbing a balloon against your hair

Negative charges are transferred from glass to silk

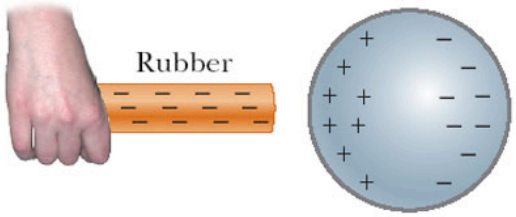


Application: static electricity

Charging by Conduction

Charged rubber rod near conductor (where charges can move freely).

Negative charges repel e⁻'s on the conductor, attract +'s



(a) Before

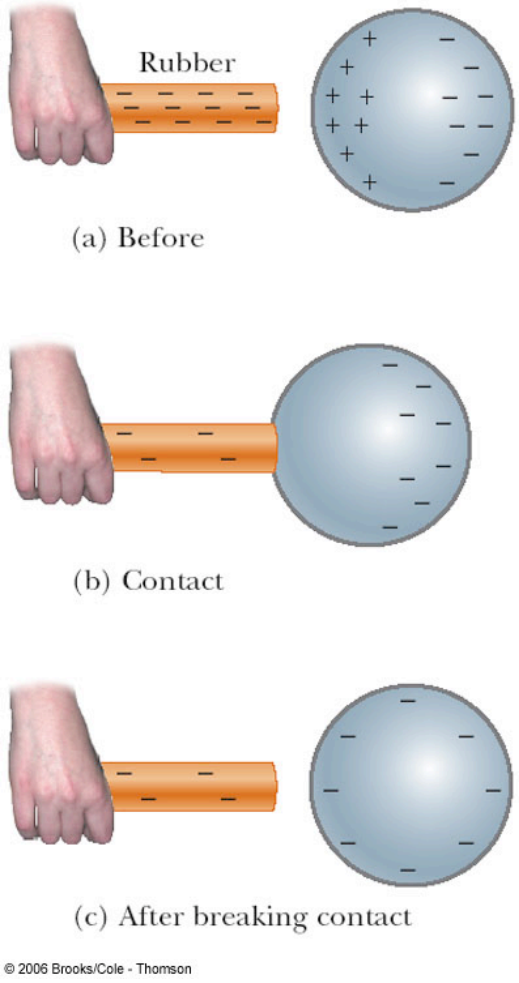
Charging by Conduction

Charged rubber rod near conductor (where charges can move freely).

Negative charges repel e^-'s on the conductor, attract +'s

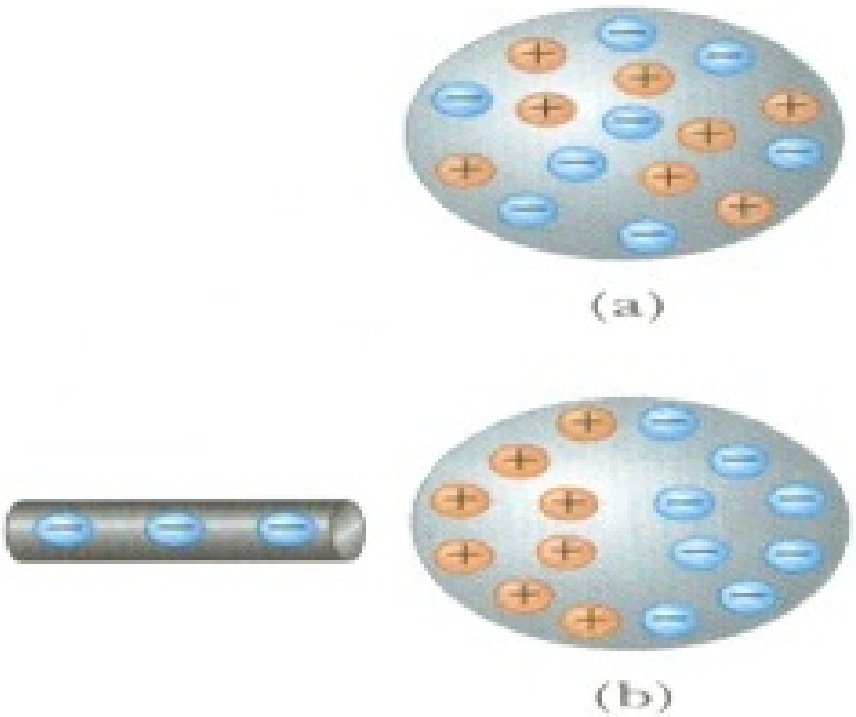
CONTACT: Some negative charges can be transferred, neutralizing the positive charges

The sphere sees a net increase of negative charges

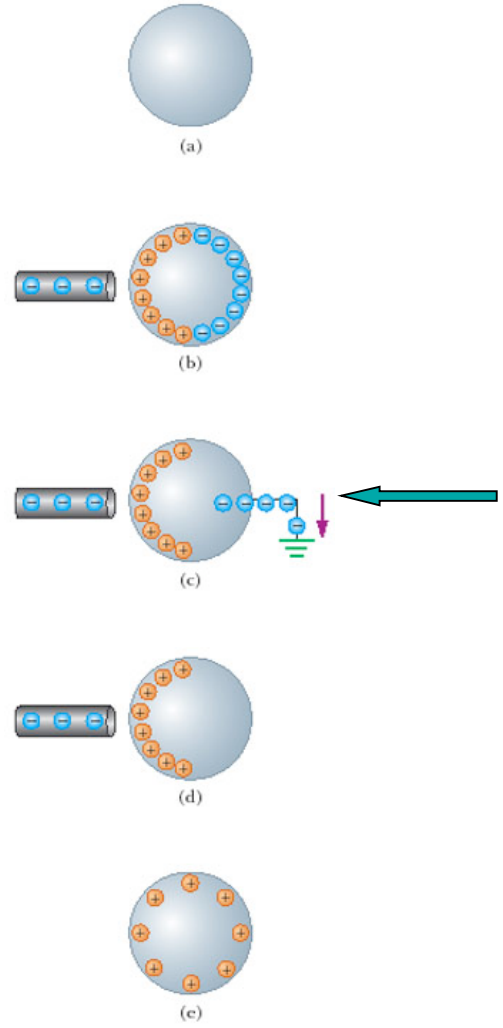


Charging by Induction

In a conductor: charges can move freely



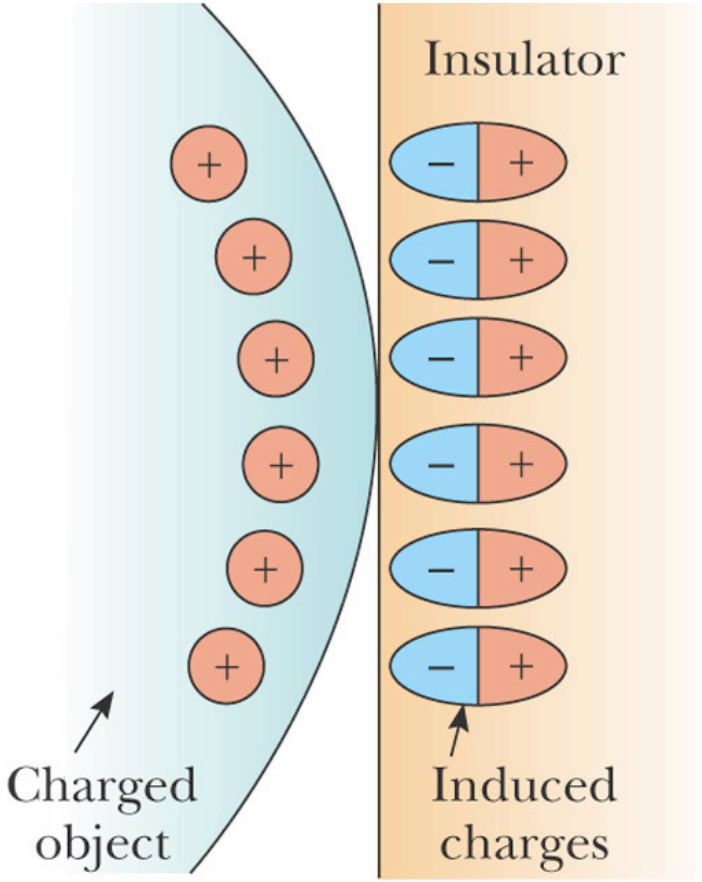
Charging by Induction



Connection to ground: a “sink” or for negative electrical charge

Question - why do only negative charges jump ship?

Charging by Induction

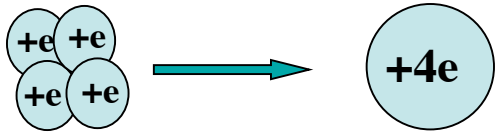


(a)

In insulators: centers of +,– charges separate slightly: POLARIZATION

Ex.: rubber balloon sticking to neutral wall

Electric Force



A collection of 4 charges, each with +1e…

…equivalent to "a charge" with +4e

Given two objects with charges q_1 & q_2:

Coulomb's Law: $F_e = \dfrac{k_e\, q_1\, q_2}{r^2}$

Coulomb constant $k_e = 8.9875 \times 10^9\ N\ m^2 / C^2$