How Things Work II
(Lecture #18)

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Course web site available through COD and Toolkit
or at http://people.virginia.edu/~gdc4k/phys106/spring08

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Your quizzes are on the lab bench at the front of the lecture hall.

Please:

• Do not put any additional marks on your quiz booklet.
• In most cases only the grade will be recorded on the second page and answers will not be marked individually.
• If you feel there has been an error in grading, you should write a note on a SEPARATE page and submit it to me after class.
• It is possible although highly unlikely that your quiz was graded with the wrong key (we found one case and checked many many more). If you suspect this is the case, you may submit your quiz to be checked.
Quiz Results

- Average = 64.3
Quiz Results

Possible D’s and F’s
But they don’t need to be!!

C's  | B's  | A's
---|---|---
19  | 47  | 31
29  | 51  | 13
7   | 51  | 8
0   |     | 0

Average = 64.3
Average Quiz Score versus raw clicker points
(numbers in parenthesis are the raw number of people who had that number of clicker points)

Average = 64.3
Announcements

• The midterm will be Wednesday, March 12th.
  - Will cover everything through chapter 11.

• Problem Set #3 is posted and is due at 23:59:59 Monday evening, March 3rd.

• Office hours this week will be Wednesday 2-3 (right here) and Thursday 2-3:30 in room 120 or my office.
Electric motors and devices that use current in a coil and a magnet
A “brushed” D.C. electric motor

- This is essentially the type of motor in the lecture demo.
- When current runs through the coils of the rotor, the rotor essentially becomes a magnet that wants to reorient itself.
- When the rotor does reorient itself, the commutator ensures that the current is flowing in such a way that the rotor again wants to reorient itself.
How a commutator works in an electric motor

At these times the commutator ensures that the electromagnet is connected one way.

At this point the split rings rotate to the point where the connections are reversed.

At these times the commutator ensures that the electromagnet is connected the other way.

Time
Another “brushed” D.C. electric motor

- Rather than thinking of the rotor as a small electromagnet, we can equivalently think in terms of forces on current-carrying wires.
- Here it is perhaps easier to see the segments of wire on which there are forces.

The commutator insures that the current always runs in the same direction in the wire that is nearest a given pole face.
A “brushed” D.C. electric motor

- Again, the commutator ensures that current is always running through the wire loops in a way that will result in forces that tend to spin the rotor.
AC synchronous electric motors

- You don’t need a commutator because the AC power reverses polarity anyway, but at exactly 60 Hz.
- In a very real way, an AC synchronous motor is just an electric generator being run in reverse.
Electronics and power adapters
Observations about power adaptors
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• AC power goes in and DC power goes out.
Observations about power adaptors

- AC power goes in and DC power goes out.
- Different adaptors have
Observations about power adaptors

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- Different adaptors have
  - different output voltages
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• Get warm when in use.
Observations about power adaptors

• AC power goes in and DC power goes out.
• Different adaptors have
  – different output voltages
  – different output currents
  – different input voltages
• Get warm when in use.
• While this is less obvious, different power adaptors supply different “qualities” of output voltage.
“Medium quality”
power adaptor circuit
“Medium quality” power adaptor circuit

- The circuit contains:
  - a transformer,
  - four diodes,
  - and a capacitor.
What do you get with nothing but a transformer?

* Induction losses generate heat (not 100% efficient)
Diodes: one-way valves for electric current
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- Made from “doped” (impurities intentionally introduced) semiconductor materials.
- Pure semiconductors are normally insulators.
- Doped semiconductors are normally conductors.
  - **P-type**: Impurity ions make positive “holes”.
  - **N-type**: Impurity ions donate negative electrons.
- Diodes are made by forming a junction of P-type and N-type materials, called a **P-N junction**.
What can you do with one diode?

"Half-Wave" Voltage Rectifier ... AC to DC