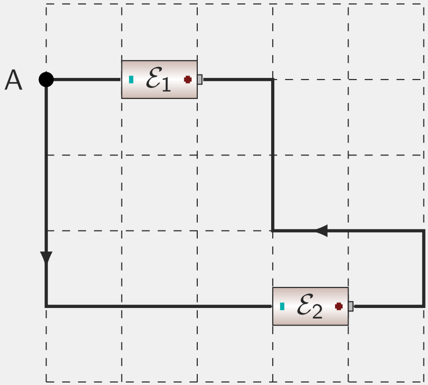
Announcements

- Homework
  - Webwork 14 tonight!
  - Video HW over the weekend
- Test 2 still a week from today
  - I'll post study materials by tomorrow (got a lot on my plate suddenly. . .)
  - Working out details still
- Polling: `rembold-class.ddns.net`

The Future

- Plan to stream lectures via Youtube, though that may change
  - Same time, MWF
  - Will still have polling for classroom feedback, and chat features for in class questions
- Already have Campuswire to streamline asking and answering of questions
  - CHECK this, it is going to be my primary point for for conveying information to you
- I will probably figure out a time and place to have some video/voice question and answer times as well
- Lab will still be happening in some form, you should be being contacted by Michaela about that
- Attendance will still be established from responses to the class polls

Review Question



Starting at point A and proceeding counter-clockwise around the loop, what equation best describes the conservation of energy in the circuit? You can assume both wires are the same and each have $\left|\vec{\mathbf{E}}\right| = E$. Let each grid box be a meter and the current direction as shown.

A. $6E + \mathcal{E}_2 + 7E + \mathcal{E}_1 + E = 0$

B. $-6E - \mathcal{E}_2 - 7E - \mathcal{E}_1 - E = 0$

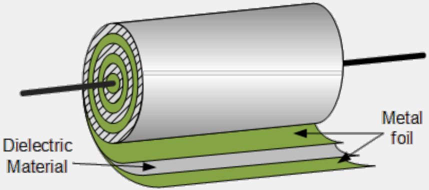
C. $6E - \mathcal{E}_2 + 7E + \mathcal{E}_1 - E = 0$

D. $-6E + \mathcal{E}_2 - 7E - \mathcal{E}_1 - E = 0$

Solution: $-6E + \mathcal{E}_2 - 7E - \mathcal{E}_1 - E = 0$

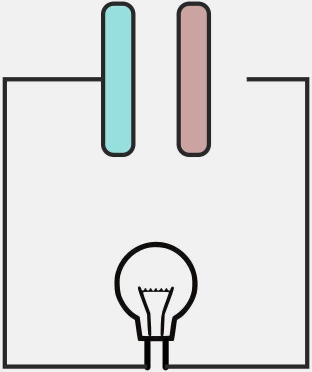
Capacitor Refresher

- "Reservoirs" of charge separated from one another
  - Somewhat analogous to lakes or reservoirs of water
- We are most familiar with plate capacitors, but can come it much more compact forms
- Always need to be separated by an insulator



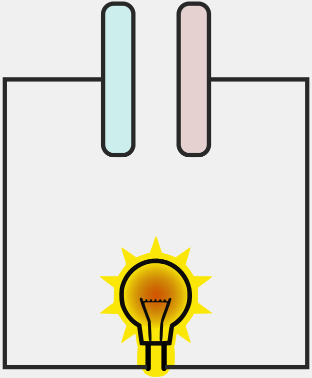
Capacitor Discharge

- Say we take a charged capacitor and put it in a circuit with a light



Capacitor Discharge

- Say we take a charged capacitor and put it in a circuit with a light
- Excess electrons on plate are going to be repelled away
  - Current initially going to be high, bulb bright
  - As charge on plates depletes, electric field lessens
  - Lessening electric field means less current, bulb dims
  - Lessening current means the charge on the plates depletes slower



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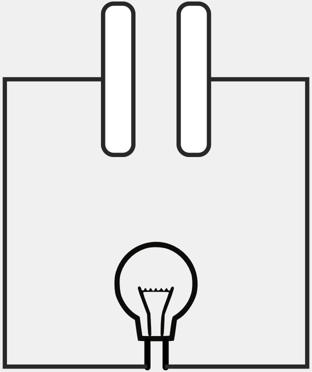
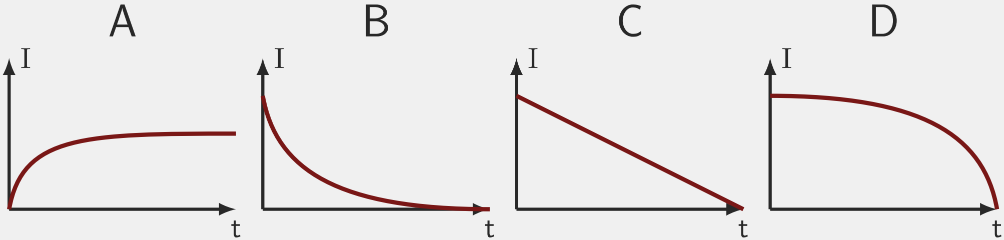
- Eventually, plates fully depleted, system in equilibrium



Capacitor Charging

- Proceeds in a very similar fashion
  - Initially no charge on capacitor, battery easily separates charges
  - Half of capacitor starts accumulating positive charge, half negative charge
  - Pushing subsequent charges onto the plates is more difficult
    - Charges already there will repel incoming charges
    - Current drops
  - At some point the potential drop across the capacitor equals the emf
    - Current drops to zero

Which of the plots best describes the current running through a lightbulb as a capacitor charges in series?



Solution: B

Uses of Capacitors

- Power “Smoothers”
  - When attached in parallel, can compensate for power fluctuations (or interruptions)
  - Get passively charged by the emf and then can respond with a needed potential difference if the emf is interrupted
  - Used if you need a really smooth current or to protect against outages
  - Can function similar to batteries
- Rapid Expenditure of Charge
  - Batteries can only push charges around at a certain speed
  - Sometimes you need a quicker response
  - Capacitors are limited only by how fast the charge can flow, which is very fast
  - Lots of uses in high current, rapid discharge, electronics:
    - Defibrillators
    - Camera flashes

Capacitance

- Want a measure of how much charge can be stored given a certain voltage
- The bigger the charge stored, the larger the electric field, so the larger the potential difference
- Since the exact form of the electric field can vary by capacitor design, we relate them with a constant:

$$Q = C|\Delta V|$$

  where C is called the capacitance.
    - Units of C/V or a Farad (F)

Capacitance of Parallel-Plate Capacitor

Let's determine the capacitance of a parallel-plate capacitor given what we know about the electric field. Take a general capacitor with plates of area A and separated by a distance s.

Solution: $C = \frac{\epsilon_0 A}{s}$