Kirchhoff Circuit Laws

Lecture 13

Announcements

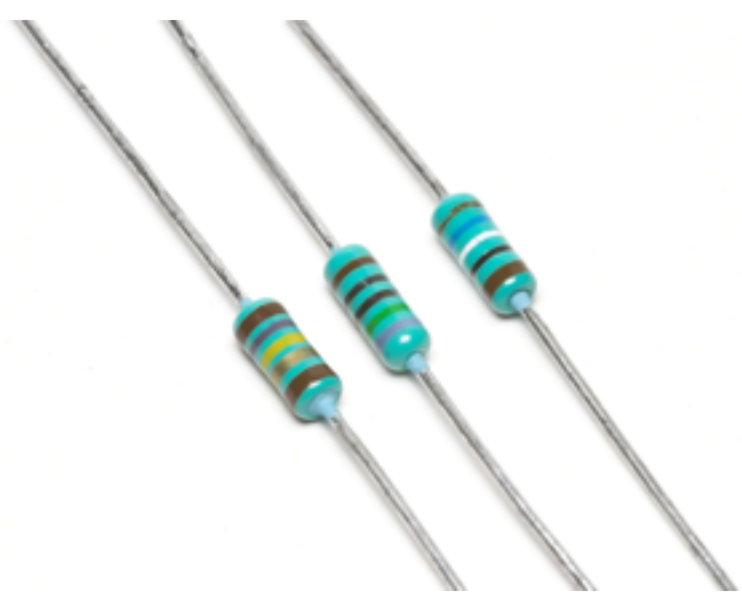
- Exam next Thursday
  - Covers material up to and including today's lecture
  - No RC circuit material
- At a conference on Monday (guest lecturer)
- Office Hours (for next week only)
  Wednesday 3-4 PM

Units

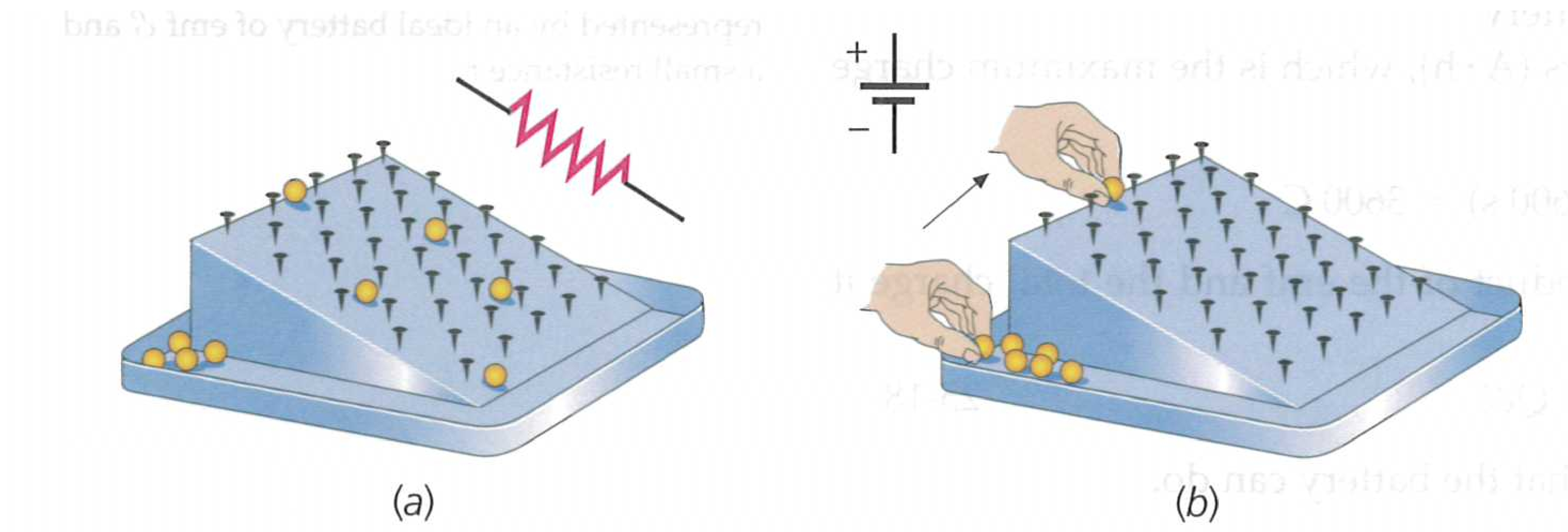
- [I] = [Current] = [Charge / Time] = C/s
  Ampere = A = Amp

- [V] = [Energy/Charge] = J/C = Volts = V

- [R] = [Resistance] = V/A = Ohms = Ω



One more analogy…



Electromotive force

- **EMF**: Historical name for **voltage gain** in a battery
- Work done per unit charge to increase/decrease its potential

$$[\mathcal{E}] = \mathcal{V}$$

Power: Supplied and Dissipated

- Power supplied by a source of emf (voltage supply)

$$P = IV$$

- Power dissipated by a ohmic resistor (to heat):

$$P = IV = RI^2 = V^2/R$$

- Units: [Power] = J/s = Watts = W

Kirchhoff Laws:

- **Current Rule:** $\sum I_{\rm in} = \sum I_{\rm out}$

  DH: “What goes is must come out.”

- **Voltage Rule:** $\sum \Delta V = 0$ around any loop

  DH: “What goes up must come down.”

- (Can be tricky to implement.)

Solving Circuit Problems

1. Use equivalent resistance & re-order components

2. Define and draw current arrow in all wires

3. Define and draw loops for voltage rule
   (covering all wires)

4. Apply Kirchhoff Rules to generate equations
   (**tricky**)

5. Solve algebraic equations for currents
   (**time consuming**)