University of Virginia

Department of Physics

Physics 606: How Things Work II

Lecture #14 Slides:

Magnetically Levitated Trains II

and

Flashlights

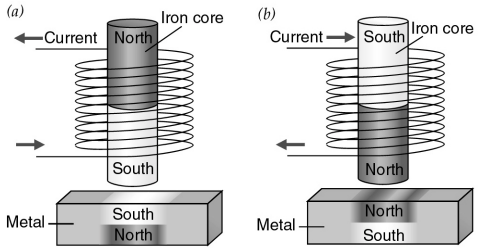
Electromagnetic Induction

- Changing magnetic field → electric field
- Electric field in conductor → current
- Current → magnetic field
- Induced magnetic field opposes the original magnetic field change (Lenz's law)

Levitation & Stability

- Unstable Levitation Schemes
  - Static permanent magnets
- Stable Levitation Schemes
  - Permanent magnets and contact
  - Dynamic stabilization with permanent magnets
  - Electromagnets and Feedback
  - Alternating Current Levitation

Alternating Current Levitation



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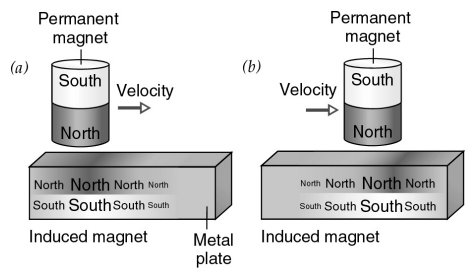
  - Electrodynamic Levitation

Electrodynamic Levitation



Flashlights

Question:

If you remove the 2 batteries from a working flashlight and reinstall them backward so that they make good contact inside, will the flashlight still work?

Observations About Flashlights

- They turn on and off with a switch
- More batteries usually means brighter
- The orientation of multiple batteries matters
- Flashlights dim as batteries age
- Sometimes smacking a flashlight brightens it

A Battery

- Battery “pumps” charge from – end to + end
  - Chemical potential energy is consumed
  - Electrostatic potential energy is produced
- Current undergoes a rise in voltage
  - Alkaline cell: 1.5 volt rise
  - Lead-acid cell: 2.0 volt rise
  - Lithium cell: 3.0 volt rise
- Chain of cells produces larger voltage rise