Radio

Question:

If you took an electrically charged ball and shook it up and down rapidly, charges in a nearby metal object would move in response. How far away could that metal object be and still respond?

1. 1 meter
2. 1 kilometer
3. The other side of the universe

Observations About Radio

- Transmit sound long distances without wires
- Involve antennas
- Seem to involve electricity and magnetism
- Reception depends on antenna positioning
- Reception weakens with distance
- Two styles of radio: AM and FM

Electromagnets and Energy

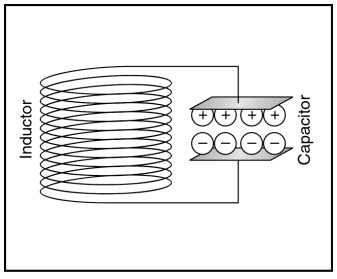
- Electric and magnetic fields contain energy
- An electromagnet stores magnetic energy
- Electromagnet consumes energy as it turns on
  - Current temporarily experiences a voltage drop
- Electromagnet releases energy as it turns off
  - Current temporarily experiences a voltage rise
- Electromagnet opposes current charges

Inductors

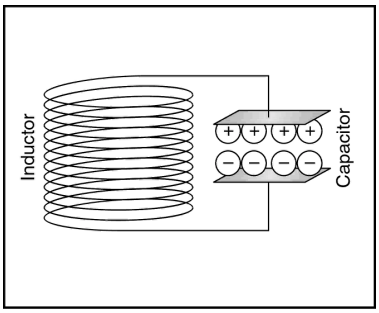
- Inductors are electromagnets
- Inductors store magnetic energy
- Inductors oppose changes in current

Tank Circuit

- Inductor & Capacitor share energy
- Charge flows back and forth through inductor
- Energy shifts back and forth between the two devices



Tank Circuit Oscillation

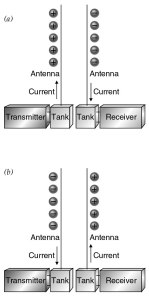


Tank Circuits in Radio

- Tanks are resonant devices
- Tanks build up energy at a specific frequency
- Tanks help radios emit radio waves
- Tanks help radios detect radio waves

Emitting Radio Waves 1

- A transmitter uses a tank circuit to "slosh" charge up and down its antenna
- A receiver uses a tank circuit to detect charge "sloshing" on its antenna
- Transmitter antenna charge affects receiver antenna charge

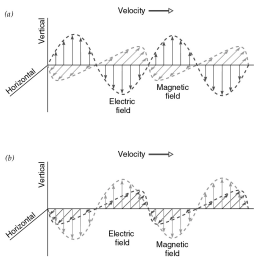


Emitting Radio Waves 2

- Accelerating charge emits radio waves
  - Charge produces electric field
  - Current produces magnetic field
  - Changing current produces changing magnetic field, produces changing electric field, prod…
- A radio wave consists only of an electric and magnetic field
- A radio wave travels through empty space at the speed of light

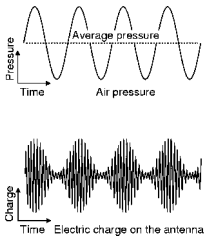
Structure of a Radio Wave

- Electric field is perpendicular to magnetic field
- Electric field creates magnetic field and vice versa
- Electric field determines polarization of the wave



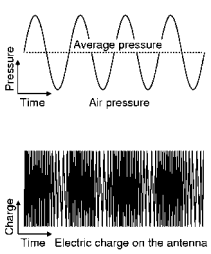
AM Modulation

- Information is encoded in the fluctuating amplitude of the wave
- Pressure variations cause changes in the amount of charge moving on the antenna



FM Modulation

- Information is encoded in the exact frequency of the charge motion
- Pressure variations cause slight shifts in the frequency of charge motion on the antenna



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