Microwave Ovens

Question:

If you put a CD in a microwave oven, it will

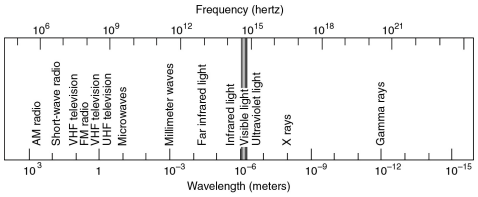
1. do nothing.
2. burn up the microwave oven.
3. burn up the CD.

Observations About Microwaves

- Microwave ovens cook food from inside out
- They can cook foods unevenly
- They don't defrost foods well
- You shouldn't put metal inside them?!
- Do they make food radioactive or toxic?

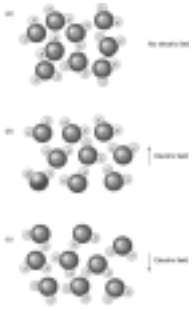
Electromagnetic Spectrum

- Long-wavelength EM waves: Radio & Microwave
- Medium-wavelength: IR, Visible, UV light
- Short-wavelength: X-rays & Gamma-rays



Water Molecules

- Water molecules are unusually polar
- An electric field orients water molecules
- A fluctuating electric field causes water molecules to fluctuate in orientation



Microwave Heating

- Microwaves have fluctuating electric fields
- Water molecules orient back and forth
- Liquid water heats due to molecular "friction"
- Ice doesn't heat due to orientational stiffness
- Steam doesn't heat due to lack of "friction"
- Food's liquid water content heats the food

Effects of Microwaves

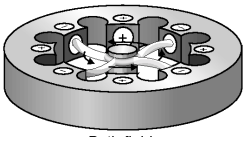
- Non-Conductors: Polarization
  - Mobile, polar molecules orient and heat
  - Immobile, polar molecules do nothing much
  - Non-polar molecules do nothing much
- Conductors: Current flow
  - Good, thick conductors reflect microwaves
  - Poor conductors experience resistive heating
  - Thin conductors experience resistive heating

Interference

- Identical waves that overlap can interfere
- Interference is when the fields add or cancel
  - Adding fields are constructive interference
  - Canceling fields are destructive interference
- Reflects cause interference in a microwave
- Interference causes uneven cooking
- Good microwaves "stir" waves or move food

Generating Microwaves

- Magnetron tube has tank circuits in it
- Streams of electrons amplify tank oscillations
- A loop of wire extracts energy from tanks
- A short ¼-wave antenna emits the microwaves



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