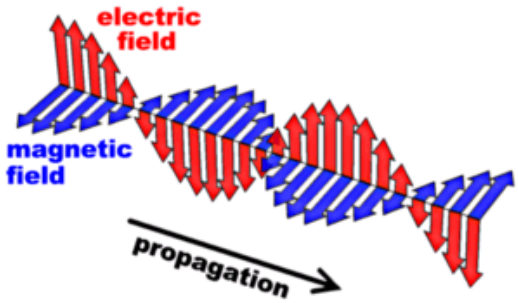
”Concert A" corresponds to a frequency of 440 Hz. Does that mean that a flute playing concert A is emitting low frequency (440 Hz) electromagnetic radiation which we detect?

A) Yes
B) No




$c = \lambda/T = \lambda f$

Are you interested in Science/Engineering/Mathematics & teaching (and a job when you graduate?), check out….

CU Teach *and learn!*

UNIVERSITY OF COLORADO AT BOULDER

**CU Teach** is a way to *earn your A&S degree* AND *graduate licensed to teach in science or math* at the secondary level in Colorado, all in four years!

**Don't know if you are interested in teaching? Find out** through CU Teach's Step I course (EDUC 2020). The 1 credit Step 1 class will give you a chance to experience elementary school teaching first hand. Love it? then enter the CU Teach program; don't love it, then at the very least you have broadened your experience in a real world way.

Check it out at
www.colorado.edu/cuteach
or **google: CU Teach**.

October 2010



Light carries energy!

**POWER** is
energy/time
(J/s, or "Watts")

**INTENSITY** is
power/area (or power/m^2)
or
energy per second per m^2

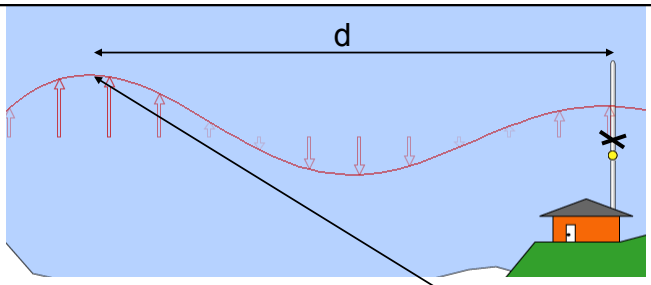
**So:**

Energy = power * time

(Joules, or “kW*hrs”)

Energy = intensity * time * area





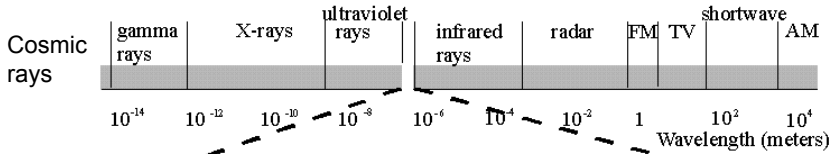

How much time will pass before this peak reaches antenna?
c=speed of light

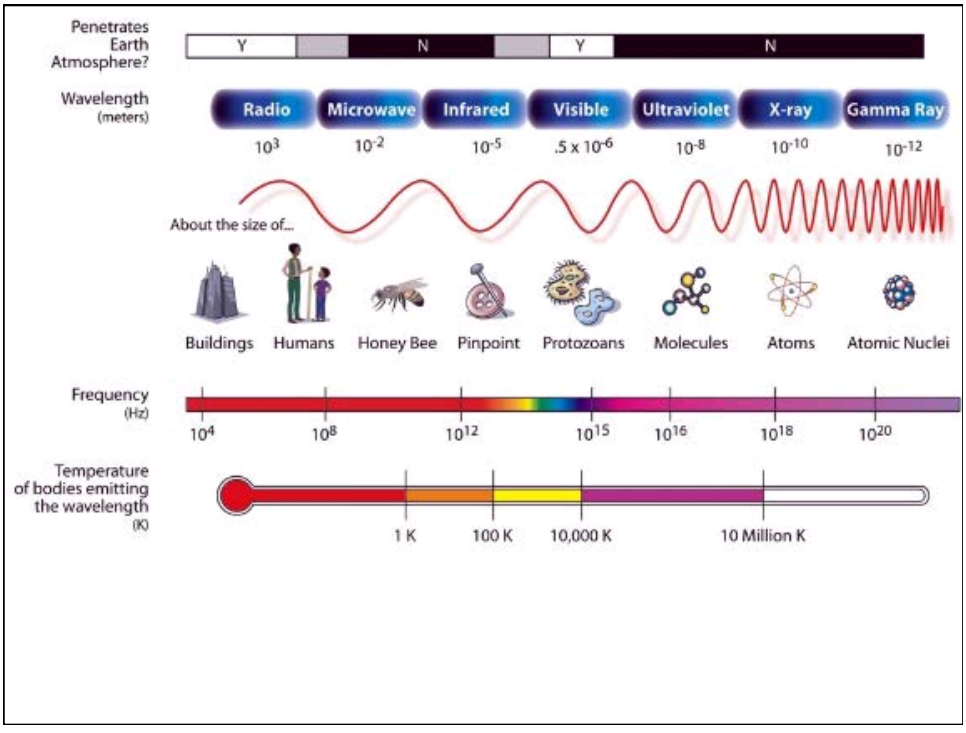
a. cd b. c/d c. d/c

d. sin(cd) e. none of the above

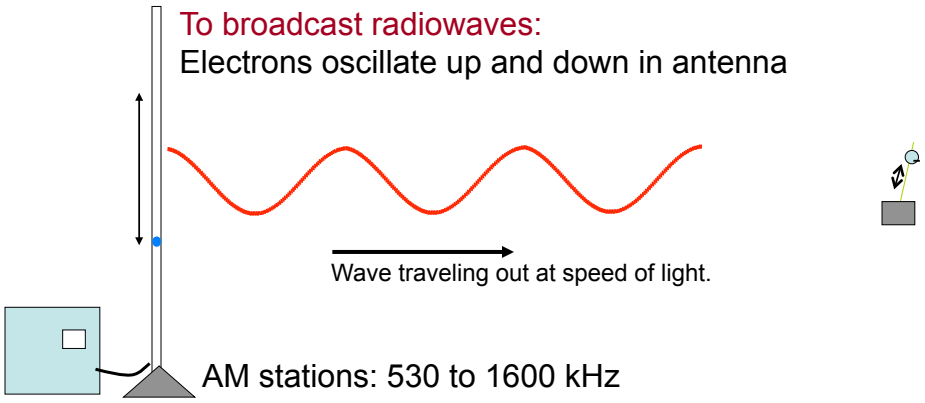
# Electromagnetic Spectrum

Spectrum: All EM waves. Complete range of wavelengths.



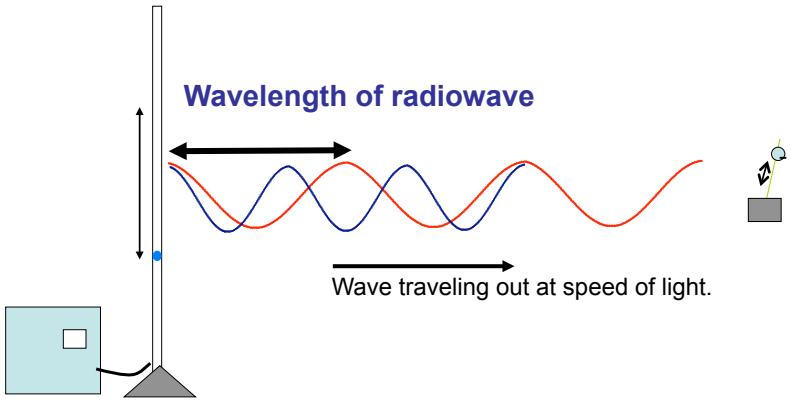
To broadcast radiowaves:
Electrons oscillate up and down in antenna




AM stations: 530 to 1600 kHz

(530 kHz means 530,000 cyles per sec:
530,000 complete oscillations of electron up and down/sec)

**Wavelength of radiowave**



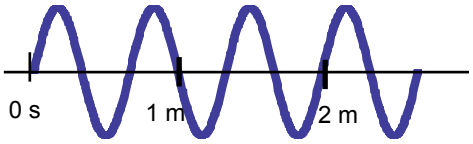

If electrons oscillate up and down more times per second (higher frequency), the wavelength of the radio wave will:

a. Increase b. Decrease c. Stay the same.

$$f \times \lambda = c = 3 \times 10^8 \text{ m/s}$$

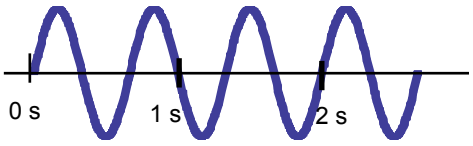
wave sim

The graph shows E as a function of *position* (at a fixed moment in time, it's a "snapshot"). What is the *wavelength* of this wave?



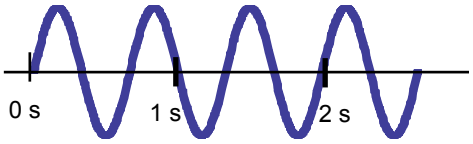

A) 0.33 m B) .67 m
D) 1.0 m D) 1.5 m
E) None of these/not enough information!

The graph shows E as a function of time. What is the *period* of this wave?




A) 0.33 sec B) .67 sec
D) 1.0 sec D) 1.5 sec
E) None of these/not enough information!

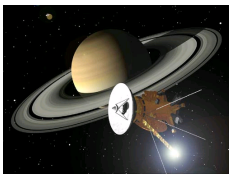
The graph shows E as a function of time.
What is the *frequency* of this wave?




A) 0.33 Hz B) .67 Hz
D) 1.0 Hz D) 1.5 Hz
E) None of these/not enough information!

NASA's Cassini probe orbits Saturn, and radios earth at a frequency of 8 GHz ($8 \times 10^9$ Hz). If Cassini doubles the frequency to 16 GHz, the time required for the radio signal to travel from Cassini to Earth will

A) Increase
B) Decrease
C) Remain constant
D) Not enough info

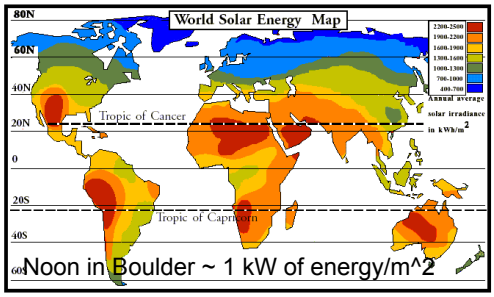


A radio wave of wavelength 2 meters passes by a person with a radio receiver. E and B go up and down as the wave travels past. After 1 second, the number of waves that moved past the person is:

A) 1 wave
B) 3E8 waves
C) 1.5E8 waves
D) 6E8 waves
E) None of these!

A radio wave of $\lambda$ =20 m passes by a person with a radio receiver. Later, a new radio wave passes the person. She observes that E and B oscillate 10x faster than the original wave. What is the best conclusion?

A) Second wave has $\lambda$=0.2 m
B) Second wave has $\lambda$ =20 m
C) Second wave travels 10x faster
D) Second wave has 1/10 the frequency
E) None of these!




My roof panels generated 3.5 MW hrs last year
(so, they were roughly 10% efficient)

How many solar collectors would you need to replace a 4 kW hot water heater?
Useful facts:
Solar thermal panels are ~ 50% efficient.
Typical solar panels are ~1m x 2m
Sunshine in Boulder delivers ~ 1 kW/m$^2$

A) 1 panel B) 2 panels C) 4 panels
D) 8 panels E) This will never work