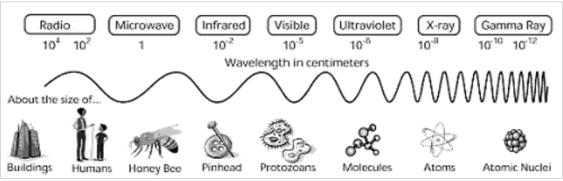
Physics 1161: Lecture 15

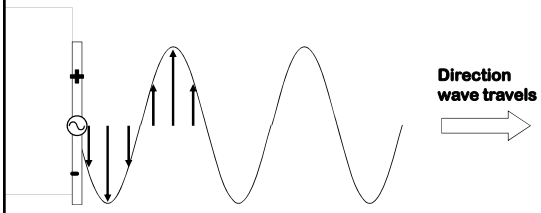
Electromagnetic Waves

- **Textbook Sections** 25-1 – 25-5

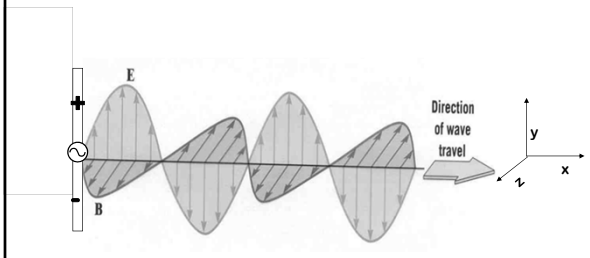


Electromagnetic Waves

Generator creates E field up and down.

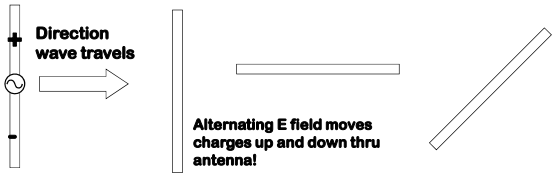


Electromagnetic Waves



Which direction should I orient my antenna to receive a signal from a vertical transmission tower?

1. Vertical
2. Horizontal
3. 45° angle

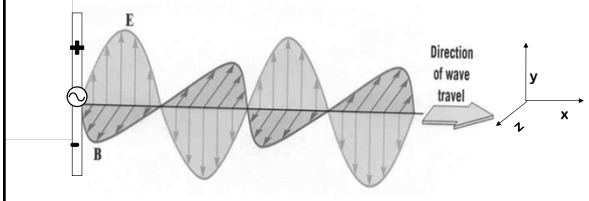


Checkpoint
EM Wave

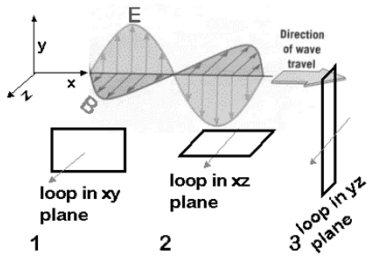
- An electromagnetic wave is travelling along the x-axis, with its electric field oscillating along the y-axis.
- In what direction does the magnetic field oscillate?
  - along the x-axis
  - along the z-axis
  - along the y-axis

Electromagnetic Waves

Generator also creates B field into and out of the page!



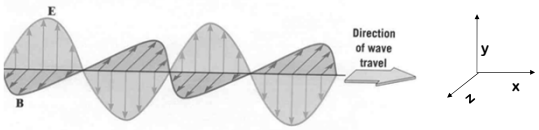
Checkpoint
E-M Wave Detection



Which of the loops will detect the electromagnetic wave?

(1) x-y plane (2) x-z plane (3) y-z plane

Electromagnetic Waves



- Transverse (vs. sound waves – longitudinal)
- E perpendicular to B and always in phase
  E & B increase and decrease at same times
- Can travel in empty space (sound waves can't!)
- "Speed of light": $\mathbf{v = c = 1/\sqrt{(\varepsilon_0 \mu_0)} = 3 \times 10^8\ m/s}$
  (186,000 miles/second!)
- Frequency: $f = v/\lambda = c/\lambda$

Checkpoint
Transverse Waves

Which of the following are transverse waves?

- sound
- light
- radio
- X-ray
- microwave
- "The Wave" (i.e. at football games)

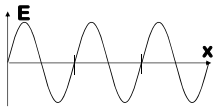
Example

EM Waves Practice

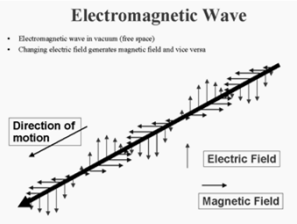
Shown below is the E field of an EM wave broadcast at 96.1 MHz and traveling to the right.

(1) What is the direction of the magnetic field?

(2) Label the two tic marks on the x axis (in meters).

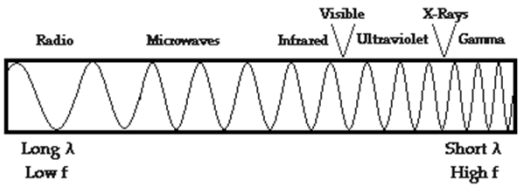


Electromagnetic Wave

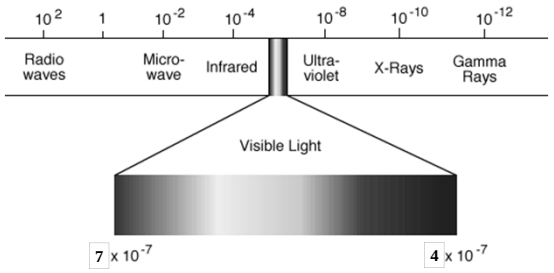


- Transverse
- Traveling oscillating electric field and magnetic field
- Can travel through space
- Generated by accelerated charges
- Emitted by excited atoms when they return to ground state

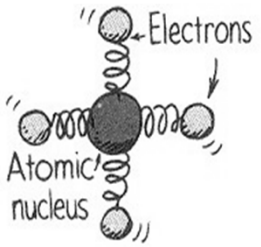
Electromagnetic Spectrum



Visible Part of Spectrum



Spring Model



- Electrons can be modeled as particles connected to the atomic nucleus by springs
- Electrons of atoms in glass have certain natural frequencies of vibration

Light Transmission