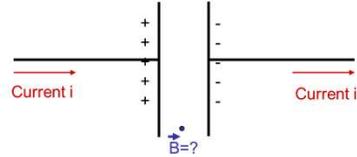
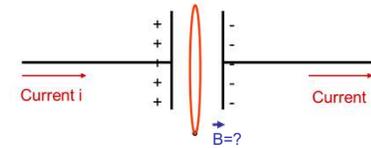


Consider the Biot-Savart Law for magnetic fields. Is there a magnetic field at the point labeled between the plates?



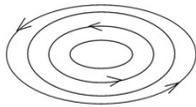
- A) Yes, there is a B-field
- B) No, there is zero B-field

Now consider an Amperian Loop as drawn. According to Ampere's Law is there a magnetic field at the point labeled between the plates?



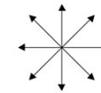
- A) Yes, there is a B-field
- B) No, there is zero B-field

Consider the following configuration of field lines. This could be a...



- A) E-field
- B) B-field
- C) Either E or B

Consider the following configuration of field lines. This could be a...



- A) E-field
- B) B-field
- C) Either E or B

Two traveling waves 1 and 2 are described by the equations

$$y_1(x, t) = 2 \sin(2x - t)$$

$$y_2(x, t) = 4 \sin(x - 2t)$$

The wavelength λ of wave 1 is most nearly...

- A) 1 m
- B) 2 m
- C) 3 m
- D) 4 m
- E) Impossible to tell

Two traveling waves 1 and 2 are described by the equations

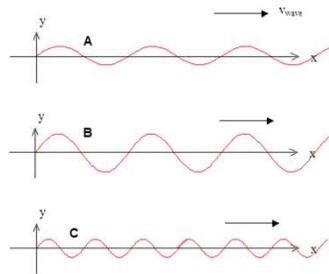
$$y_1(x, t) = 2 \sin(2x - t)$$

$$y_2(x, t) = 4 \sin(x - 2t)$$

All the numbers are in the appropriate SI units. Which wave has the higher speed?

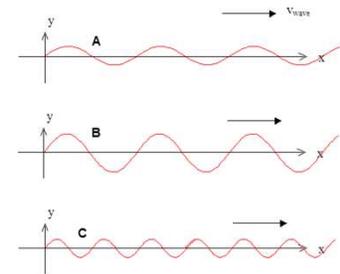
- A) Wave 1
- B) Wave 2
- C) Both have the same speed

Three waves are traveling along identical strings (same mass per length, same tension, same everything). Wave B has twice the amplitude of the other two. Wave C has 1/2 the wavelength than A or B. Which wave goes slowest?



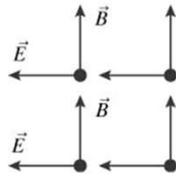
- A) A
- B) B
- C) C
- D) All have same v

Three waves are traveling along identical strings (same mass per length, same tension, same everything). Wave B has twice the amplitude of the other two. Wave C has 1/2 the wavelength than A or B. Which wave has the highest frequency?



- A) A
- B) B
- C) C
- D) All have same f

A plane electromagnetic wave has electric and magnetic fields at all points in the plane as noted below. With the fields oriented as shown, the wave is moving...



- A) into the plane of the paper
- B) out of the plane of the paper
- C) to the left
- D) to the right
- E) toward the top of the paper

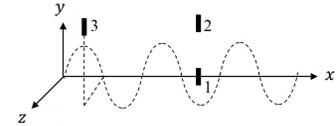
An EM plane wave is described by,

$$\vec{E}(x, t) = E_0 \sin(kx - \omega t) \hat{y} \quad \vec{B}(x, t) = B_0 \sin(kx - \omega t) \hat{z}$$

The figure shows the electric field at $t = 0$ with a dashed line.

Consider 3 antennas, labeled 1, 2, and 3

- Antenna 1 is on the x axis.
- Antenna 2 is in the xy plane, above 1.
- Antenna 3 is off the x axis at the location shown.



Rank the antennas by the **rms average** signal strength received, from largest to smallest:

- A) 1>2>3
- B) 1=2=3
- C) 1=2>3

Which has higher frequency?

- A) Red light
- B) Violet-blue light
- C) Both have the same frequency
- D) It depends on how the light is made

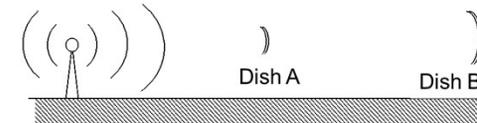
Imagine you are an alien from another planet with infrared eyes. What do you see when you look around the room?

- A) Bright spots where the bodies are and dark elsewhere.
- B) Dark spots where the bodies are and bright elsewhere.
- C) The same as what we see, only everything looks red.
- D) The same as what we see, except that red is invisible.

At a certain location, the electric field in the EM wave created by radio station P is stronger than that of radio station Q: $E_{0,P} = 2 E_{0,Q}$. How do the intensities of these waves compare? How do the magnetic fields compare?

- A) $\overline{S}_P = 8 \overline{S}_Q$ and $B_{0,P} = 2 B_{0,Q}$
 B) $\overline{S}_P = 4 \overline{S}_Q$ and $B_{0,P} = 4 B_{0,Q}$
 C) $\overline{S}_P = 4 \overline{S}_Q$ and $B_{0,P} = 2 B_{0,Q}$
 D) $\overline{S}_P = 2 \overline{S}_Q$ and $B_{0,P} = 4 B_{0,Q}$
 E) $\overline{S}_P = 2 \overline{S}_Q$ and $B_{0,P} = 2 B_{0,Q}$

Two radio dishes receive signals from a radio station which is sending out radio waves in all directions with power P . Dish B is has twice the diameter of Dish A, but is twice as far away. What is the ratio of power received (P_A/P_B)?



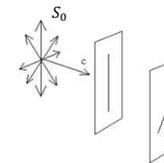
- A) 1:1
 B) 2:1
 C) 4:1
 D) 16:1
 E) None of these

An electromagnetic wave is created at point A and it propagates to point B. Consider the following statements:

- I. The wave consists of a stream of electrons that pass from A to B.
- II. An electromagnetic wave requires a "medium" of electrons that vibrate as the wave passes by.

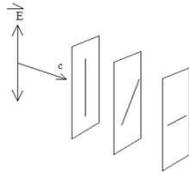
- A) Only statement I. is true
 B) Only statement II. is true
 C) Both statements are true
 D) Neither statement is true

An unpolarized beam of light passes through 2 polaroid filters oriented at 45° with respect to each other. The intensity of the original beam is S_0 . What is the intensity of the outgoing light after both filters? [Hint: $\cos 45^\circ = 1/\sqrt{2}$]



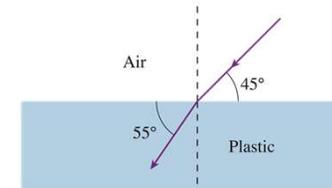
- A) $\frac{S_0}{2}$
 B) $\frac{S_0}{4}$
 C) $\frac{S_0}{8}$
 D) $\frac{S_0}{16}$
 E) none of the above

A polarized beam of light passes through three ideal polaroid filters. The filters, in order 1st, 2nd, 3rd, are tilted at 0°, 45°, and 90° with respect to the incoming beam's axis. Does any light get through the all the filters and come out the other side?



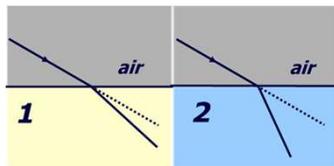
- A) Some light gets through
- B) No light gets through

What is the angle of refraction for the light ray incident from air into plastic as shown?



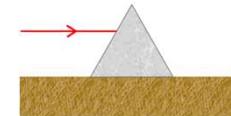
- A) 35°
- B) 45°
- C) 55°
- D) None of these

Parallel light rays cross interfaces from air into two different media, 1 and 2, as shown in the figures below. In which of the media is the light traveling faster?



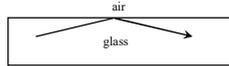
- A) Medium 1
- B) Medium 2
- C) Both the same

A horizontal light ray is incident on a triangular prism. After passing through the prism, the exiting light ray is...



- A) deflected upwards.
- B) horizontal.
- C) deflected downwards.

A light ray inside glass ($n=1.5$) is totally internally reflected from an air-glass interface as shown.



Now, the air surrounding the glass is replaced with water ($n=1.3$). With the same light ray in the glass, will total internal reflection still occur?

- A) Definitely not
- B) Definitely
- C) Not enough information to know

What will you see if you black out the bottom half of a full length mirror you're standing in front of?

- A) Your upper half
- B) Your lower half
- C) The same complete image
- D) A monster