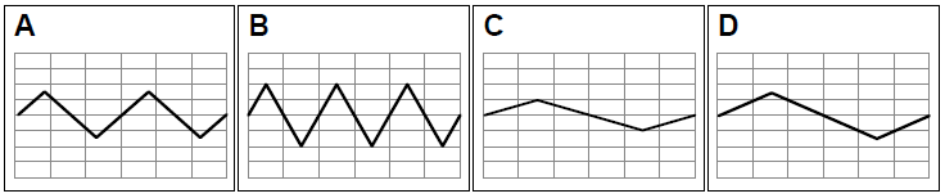
AP Physics 2 – Waves and Sound

E1-RT03: Waves with Same Frequency—Wave Speed

The drawings represent snapshots taken of waves traveling to the right along strings. The grids shown in the background are identical. The waves all have the same frequency, but their amplitudes and wavelengths vary.



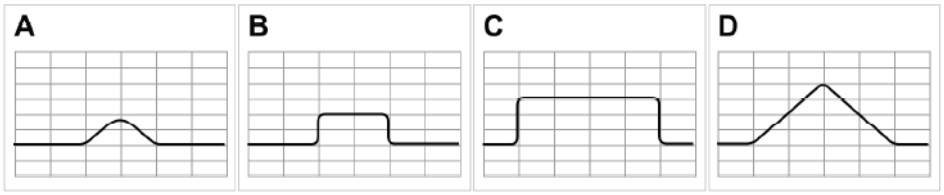
Rank the speed of the waves on the string.

				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

E1-RT04: Wave Pulses—Leading Edge Time to Travel

The drawings represent snapshots taken of waves traveling along a rope. The grids shown in the background are identical. These pulses, which vary in amplitude, are all sent down identical ropes under equal tension. The ropes are all the same length, and there is no distortion of the pulses as they travel down the ropes.



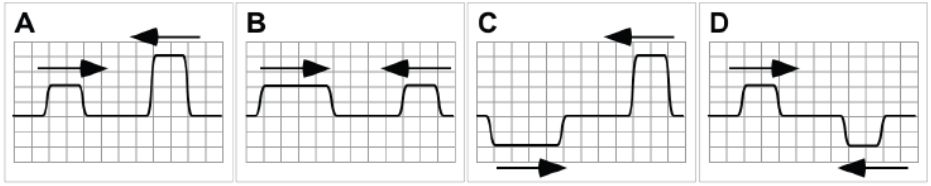
Rank the time it takes the leading edge of the pulse to travel 3 m.

				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

E1-RT05: Pairs of Transverse Waves—Superposition

Rectangular transverse wave pulses are traveling toward each other along a string. The grids shown in the background are identical, and the pulses vary in height and length. The pulses will meet and interact soon after they are in the positions shown.



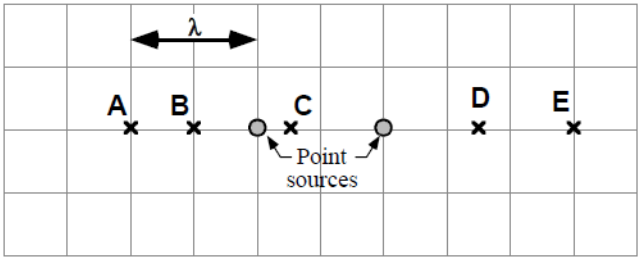
Rank the maximum amplitude of the string at the instant that the positions of the centers of the two pulses coincide.

				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

E1-QRT07: Wave Sources Separated by One Wavelength I—Interference

Two identical point sources are generating waves with the same frequency and amplitude. The two sources are in phase with each other, so the two sources generate wave crests at the same instant. The wavelength of the waves is equal to the distance between the two sources.



List all the labeled points where the waves from the two sources constructively interfere. If there are no such points, indicate that by stating "none of them." _____

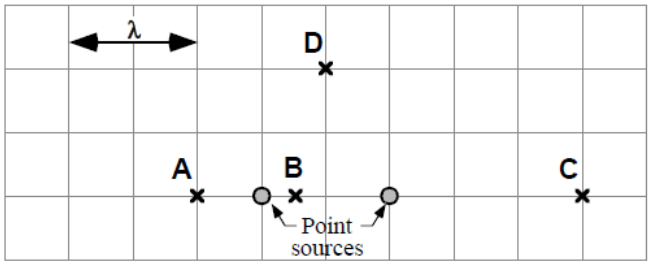
Explain your reasoning.

List all the labeled points where the waves from the two sources destructively interfere. If there are no such points, indicate that by stating "none of them." _____

Explain your reasoning.

E1-QRT10: Wave Sources Separated by One Wavelength II—Interference

Two identical point sources are generating waves with the same frequency and amplitude. The two sources are *out of phase* with each other, so at the instant that one source is creating a crest, the other source is creating a trough. The wavelength of the waves is equal to the distance between the two sources.



List all the labeled points where the waves from the two sources constructively interfere. If there are no such points, indicate that by stating "none of them." _____

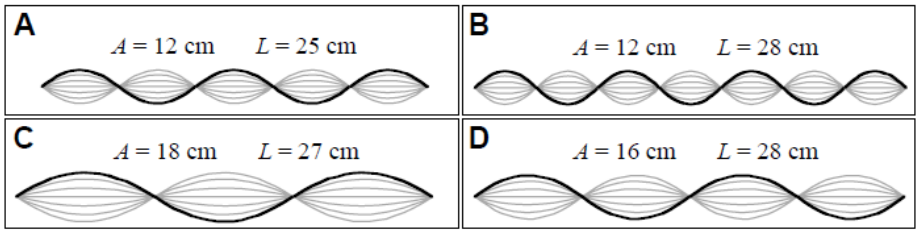
Explain your reasoning.

List all the labeled points where the waves from the two sources destructively interfere. If there are no such points, indicate that by stating "none of them." _____

Explain your reasoning.

E1-RT11: Standing Waves—Frequency

A string is stretched so that it is under tension and is tied at both ends so that the endpoints don't move. A mechanical oscillator then vibrates the string so that a standing wave is created. The dark line in each diagram represents a snapshot of a string at an instant in time when the amplitude of the standing wave is a maximum. The lighter lines represent the string at other times during a complete cycle. All of the strings are identical except for their lengths, and all strings have the same tension. The number of nodes and antinodes in each standing wave is different. The lengths of the strings (L) and the amplitudes at the antinodes (A) are given in each figure.



Rank the frequencies of the waves.

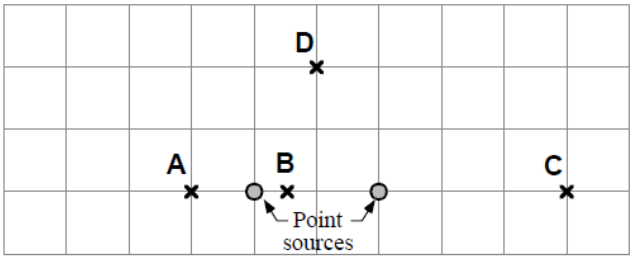
☐ ☐ ☐ ☐ OR ☐ ☐ ☐

1 Greatest, 2, 3, 4 Least, OR, All the same, All zero, Cannot determine

Explain your reasoning.

E1-RT19: Wave Source—Intensity at Various Locations

Two point sources can generate waves with the same frequency and amplitude. The sources can be turned on and off individually.



(a) Rank the intensity of the wave at the labeled points if the left point source is turned on and the right point source is turned off.

☐ ☐ ☐ ☐ OR ☐ ☐ ☐

1 Greatest, 2, 3, 4 Least, OR, All the same, All zero, Cannot determine

Explain.

(b) Rank the intensity of the wave at the labeled points if the right point source is turned on and the left point source is turned off.

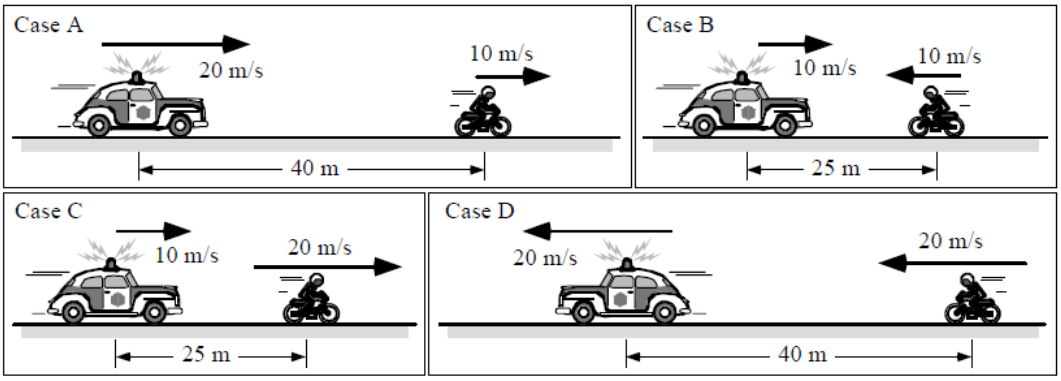
☐ ☐ ☐ ☐ OR ☐ ☐ ☐

1 Greatest, 2, 3, 4 Least, OR, All the same, All zero, Cannot determine

Explain.

E3-RT01: Police Car and Motorcycle—Siren Frequency

A police car with a 600 Hz siren is traveling along the same street as a motorcycle. The velocities of the two vehicles and the distance between them are given in each figure.



Rank the frequency of the siren as measured by the motorcycle rider.

				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

E3-QRT04: Vibrating Guitar String and Tuning Fork—Frequency

A guitar string is strummed near a tuning fork that has a frequency of 512 Hz. Initially, the guitar and tuning fork together create a sound wave with a beat frequency of 5 Hz. The tension in the guitar string is then increased, after which the guitar and tuning fork together create a sound wave with a beat frequency of 4 Hz.

(a) Before the tension in the guitar string is increased, is the frequency of the guitar string (i) *greater than* 512 Hz, (ii) *less than* 512 Hz, or (iii) *equal to* 512 Hz? If it is not possible to determine how the guitar frequency compared to 512 Hz, state that explicitly.

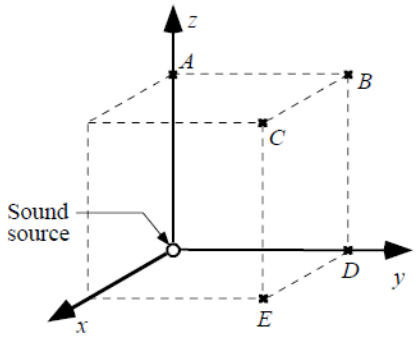
Explain your reasoning.

(b) After the tension in the guitar string is increased, is the frequency of the guitar string (i) *greater than* 512 Hz, (ii) *less than* 512 Hz, or (iii) *equal to* 512 Hz? If it is not possible to determine how the guitar frequency compares to 512 Hz, state that explicitly.

Explain your reasoning.

E3-CT10: Three-Dimensional Locations near a Sound Source—Loudness

A point sound source emits sound waves in every direction. The point source is located at the origin, and points *A*–*E* are located on the corners of an imaginary cube, as shown.



$I_B =$	I_A
$I_C =$	I_A
$I_D =$	I_A
$I_E =$	I_A

If the intensity (loudness) at the point labeled *A* is I_A, in the table to the right of the figure express the intensity at the other labeled points in terms of I_A.
Explain your reasoning.

E3-CT14: Dropped Siren—Wavelength in Water

A waterproof siren is emitting sound at a single frequency. The siren is dropped from air into water.
Is the wavelength of the waves produced by the siren in the water (i) *greater than*, (ii) *less than*, or (iii) *equal to* the wavelength of the waves produced by the siren in the air? _____
Explain your reasoning.

E1-CT16: Wave Pulses Traveling Toward Each Other—Speed

Two pulses travel toward each other along a long stretched spring as shown. Pulse A is wider than pulse B, but not as high.

Is the speed of pulse A (i) *larger than,* (ii) *smaller than,* or (iii) *equal to* the speed of pulse B? If there is not enough information to tell, state that explicitly. _____
Explain your reasoning.