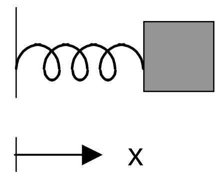
SAMPLE FIRST MIDTERM



Problem 1. A spring/block harmonic oscillator is oscillating with amplitude x_m. The block has mass m. At time t = 0, the block is at its equilibrium point with kinetic energy K, moving in the negative x direction.

Use: $x_m = 0.10$ m, m = 4.0 kg, K = 2.0 J.

(a) What is the spring constant?
(b) What is the frequency of oscillation?

Problem 2. A longitudinal sound wave is propagating in the positive x direction. Let the pressure difference with respect to room pressure be written as Δp, as usual. Write an equation for the wave, $\Delta p(x, t)$, given the following information:

At t = 0, $\Delta p = 0$ at x = 0 and x = 0.050, but not in between these locations.
$\Delta p_{max} = 0.20$

Here time, position, and pressure are in standard SI units: seconds, meters, and pascal.

Problem 3. A string is oscillating as a standing wave at the 4^{th} harmonic, with nodes on each end. The frequency is f, the string length is L, and the amplitude at the anti-nodes is A.

(a) Sketch a picture of the string when the anti-nodes are at their largest amplitude.
(b) What is the amplitude of the oscillation at a distance L/10 from one of the nodes?

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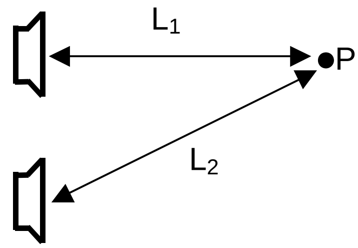
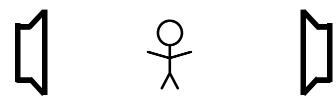
Problem 4. Two speakers are oscillating at frequency f, *but out of phase with respect to each other by π*. One is a distance L_1 from point P, and the other is a distance L_2. What are the lowest two frequencies such that the intensity will be a minimum at P?
Use: L_1 = 100 m, L_2 = 110 m.

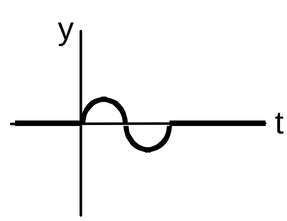


Problem 5. A person is between two speakers. In the reference frame of each speaker, the oscillation frequency is f. Both speakers are moving with speed v_s.
Use: f = 1000 Hz, v_s = 3.0 m/s.

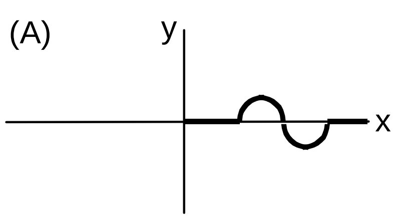


(a) What is the beat frequency if both speakers are moving to the right?
(b) What is the beat frequency if both speakers are moving toward the person?

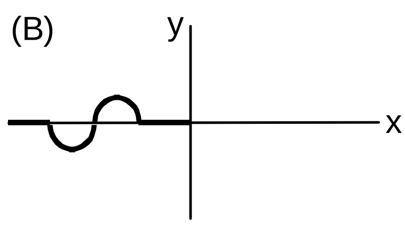
Problem 6. The graph to the right shows the time variation of a wave pulse that consists of a single cycle of a sine wave at <u>x = 0</u>. The wave is propagating in the <u>-x direction</u>. Select the letter of the graph that best shows the spatial variation of the wave pulse after some time has passed.



(A)



(B)



(C)