

Spring

Physics 133: Midterm I
Professor Frank De Lucia

2:30 Section

Name (1 pt): _____

Recitation Instructor (1 pt): _____

There are four pages to this midterm (plus an equation sheet). It is important that you write your name on each page and the name of your recitation instructor on the first page. Each name is worth one point.

Be sure to include the proper units in your answers.

Problem I.1: A traveling wave is described by

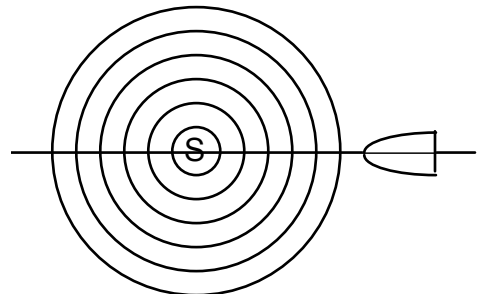
$$y(x,t) = 0.5 \sin(10\pi x - 50\pi t)$$

where the amplitude is in meters, the angular wave number (k) in rad/m, and the angular frequency (ω) in rad/s.

(a) (5 pts) What is the wavelength of the wave?

(b) (5 pts) What is the velocity of propagation of the wave?

Problem I.2 (10 pts): A source S generates circular waves on the surface of a lake; the pattern of wave crests is shown in the figure. The speed of the waves is 5.5 m/s, and the crest-to-crest separation is 2.3 m. You are in a small boat heading directly toward S at a constant speed of 3.3 m/s with respect to the shore. What frequency of waves do you observe?



Name (1 pt): _____

Problem II.1 (25 pts): There are two organ pipes of length L_1 and L_2 . The pipe of length L_1 is open on both ends, and pipe of length L_2 has one end open and one end closed. If the speed of sound is 343 m/s,

(a) What are the two lowest resonant frequencies for the pipe of length L_1 ? Draw the pipe and sketch the standing waves.

(b) What are the two lowest resonant frequencies for the pipe of length L_2 ? Draw the pipe and sketch the standing waves.

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Problem II.2 (25 pts): A 3.0 kg mass attached to a spring of force constant k is in simple harmonic motion in one dimension and moves according to the equation

$$x = (5.0\text{ m})\cos\left[\left(\frac{\pi}{3}\text{ rad/s}\right)t - \left(\frac{\pi}{4}\text{ rad}\right)\right]$$

- (a) What is the total energy of the system?
- (b) What is the force constant of the spring?
- (c) How long does it take for the system to move from $x = 5.0$ m to $x = 0.0$ m?

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Problem II.3 (25 pts): The amplitudes of two sinusoidal waves traveling in the same direction along a stretched string are 4.0 and 7.0 mm; their phase constants are 30° and 80° , respectively. The waves have the same wavelength.

- (a) What is the amplitude of the resulting wave?
- (b) What is the phase constant of the resulting wave?
- (c) Is the resulting wave a standing or traveling wave?