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Practice Midterm, Physics 1B, Winter 2020

- Please write your name and UID in the boxes on the front page and your name in the boxes on the odd numbered pages.
- Closed book, **one** 5x3in note card (both sides) allowed.
- Scientific Calculators allowed, no computers or smartphones, please put books and notebooks in your backpacks.
- If a problem is ambiguous, notify the instructor. Clarifications will be written on the blackboard. Check the board occasionally.
- Time for exam: 60 minutes
- There are 4 questions, check that your exam has all 12 pages.

Good Luck !!

-additional space for calculation- Please denote exactly which problem you are working on

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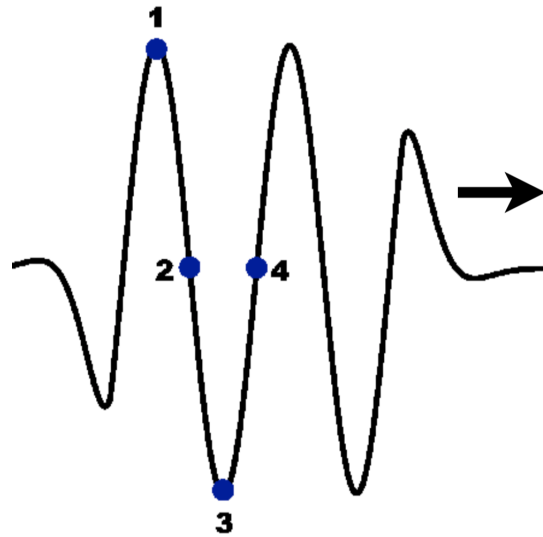
Problem 1: [15pts] Concept questions

a) [5pts] A child swings on a swing (you can model the system as a simple pendulum undergoing small oscillations). The child holds a bag of sand. When the goes though the bottom of the swing the child drops the bag of sand. What will happen to the amplitude and the frequency of the oscillation after the bag has been dropped ?

Circle the correct answer

- A** The frequency decreases and the amplitude increases
- B** The frequency decreases and the amplitude decreases
- C** The frequency is unchanged and the the amplitude increases
- D** The frequency is unchanged and the the amplitude decreases
- E** The frequency is unchanged and the amplitude is unchanged.

b) [5pts] A wave travels on a stretched cord; a snapshot of the displacement of the cord (at one instant in time) is shown below. If the wave is propagating to the right, at which point does the cord have a (non-zero) acceleration upwards?



Circle the correct answer

- A 3.
- B 2.
- C 1.
- D 4.

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c) [5pts] You play a guitar string and excite the fundamental standing mode on the string (frequency f , wavelength λ). A sound wave is generated which allows you to hear the guitar. What about the sound wave is different from the standing wave on the string?

Circle the correct answer

- A** wave speed only
- B** wave speed and frequency only
- C** wave speed, wavelength, and frequency
- D** wave speed and wavelength only
- E** frequency and wavelength only
- F** they are all the same

Problem 2: [30pts]

A mass $m = 50g$ is attached to an ideal spring on a frictionless horizontal surface. The block is pulled to stretch the spring 10 cm , then released gently. After a little time the block passes through the equilibrium position with a velocity of 1 m/s

a) [10pts] What is the block's period of oscillation ?

b) [10pts] What's the block speed at the point when the spring is compressed by 5 cm ?

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c) [10pts] You add a friction force with $F = -bv$ acting on the mass. You observe that after one oscillation the mechanical energy is $1/e$ of the value at $t = 0$. What is b ?

Problem 3: [30pts]

A tube open on both ends is filled with an unknown gas. The tube is 190cm in length and 3cm in diameter. By using different tuning forks, it is found that the resonant standing waves can be excited at frequencies of 315Hz, 420Hz and 525 Hz and there are no other resonant standing frequencies between 315 Hz and 525 Hz.

a) [10pts] What is the speed of sound in this gas ?

b) [10pts] Draw a picture of the 315Hz and 525Hz standing wave. Be sure to note whether you draw pressure or displacement amplitudes.

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c) [10pts] If one end of the tube is now closed, what would be the frequency of the tuning fork needed to be to excite the fundamental standing wave ? [If you could not do a) assume that $v = 370m/s$].

Problem 4: [30pts] On a horizontal string we model a sinusoidal travelling transverse wave by the following wavefunction

$$y(x, t) = 0.1cm \sin \left[4 \left(2\pi \frac{10}{m} x + 2\pi \frac{2000}{s} t \right) + \frac{\pi}{4} \right]$$

a) [10pts] Determine the wavelength, frequency and wave speed for this wave. Does the wave move in the positive or negative x direction ?

b) [10pts] The string on which the wave travels is under tension $T = 200N$, what's the mass of $1m$ of string ? [If you could not do part a) assume the wave speed is $v = 210m/s$.]

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c) [5pts] Calculate the average power in the wave. [If you could not do part b) assume the $\mu = .05 \text{ kg/m}$.]

-additional space for calculation- Please denote exactly which problem you are working on