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University of California San Diego
Physics 2C, Winter 2020

PRACTICE QUIZ 1-2

All students must work independently. You are allowed one page of handwritten notes only; no communication devices (cell phones, etc) permitted. Show all work; no credit will be given for answers with no derivation. Any problem asking for a vector (e.g., force) requires a vector as an answer!

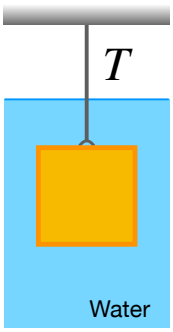
Directions: Work each problem on the exam sheet provided. Put your NAME and PID on EACH sheet (one for each problem) in the space provided. If you don't have enough room on a single side of the page, finish the problem on the back of the page. $15 + 10 + 15 + 4(3) = 52$ points total for this exam.

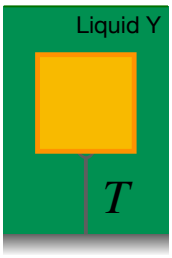
Please keep in mind the following before you turn in your exam to avoid a 10% penalty:

- Make sure your name and PID are on each sheet in the space provided.
- Turn in all 6 pages. Do not turn in this cover page. If you absolutely could not fit a problem on the front/back of a single sheet, clearly communicate this to the proctor/TA/instructor when you turn in your exam.
- Make sure your pages are in numerical order (page 1, page 2, page 3, etc.)

Name:
PID:

1. (15 points, 5 points each): When an object of mass M is completely submerged in water, it requires an upward force T to keep the object in equilibrium ("T" for "Tension" in the string holding it up). When the same object is completely submerged in "Liquid Y," it requires a *downward* force T to keep the object in equilibrium.





   (a) Draw the free-body diagrams for both situations and write down both of the force equations of the form $\sum \vec{F} = m\vec{a}$.

   (b) Rank the density of water ρ_w, the density of Liquid Y ρ_Y, and the density of the object ρ_{obj} from the least to the greatest.

   (c) Solve for ρ_{obj} in terms of ρ_w and ρ_Y.

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2. (10 points, 5 points each): A pipe of length L is closed at one end and open at the other end. The 2^{nd}-lowest harmonic frequency for the pipe is ω (angular frequency). Answer the following in terms of L:

   (a) Draw the standing wave for this 2^{nd}-lowest harmonic. What is the wavelength of this harmonic?

   (b) Suppose we want to cut the pipe so that it is open on both sides, and also so that that the fundamental angular frequency of the newly-cut pipe matches the original angular frequency ω. How long should the pipe be after you cut it?

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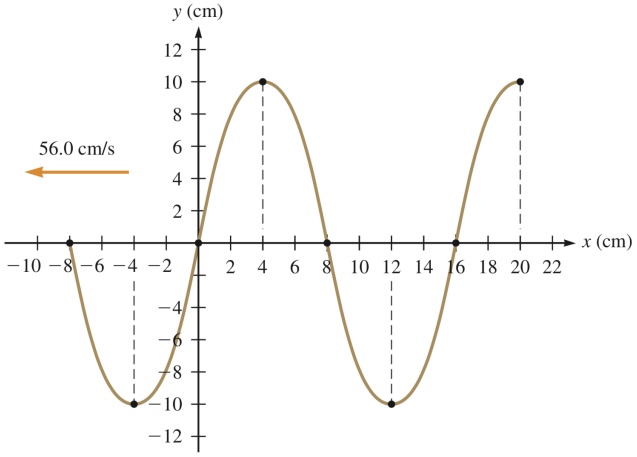
3. (15 points, 5 points each): A snapshot graph at $t = 0$ of a traveling wave is shown below:



(a) What are the wavelength (in meters) and frequency (in Hertz) of this wave?

(b) Draw a history graph (y vs. t) for the particle at $x = 0$. The horizontal part of your graph should include the times $t = 0$ and $t = T$ (where T is the period of the wave). Label your graph, including numerical values on both the horizontal as well as vertical axes.

(c) The wave can be described by the function $y(x,t) = A\cos(kx \pm \omega t + \phi_0)$. Write down this function. That is, solve for the constants A, k, and ω (all positive), find the sign, and find the value of ϕ_0, assuming it is in the range $[0, 2\pi)$, then plug it all into $y(x,t)$.

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(12 points, 4 points each): 4 Multiple-choice questions / fill-in-the-blanks on various topics.

Directions for multiple-choice questions: COMPLETELY FILL IN THE SQUARE for the answer. Directions for fill-in-the-blank questions: Your answer should be entirely in the boxed region. Include the number of significant figures ("sig. figs.") requested in the problem.

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4. When a sound wave passes from air into water, the frequency of sound waves _____ and the wavelength of sound waves _____. The speed of sound in air is 343 m/s and the speed of sound in water is 1500 m/s.

   ☐ remains the same, increases
   ☐ remains the same, decreases
   ☐ increases, increases
   ☐ decreases, remains the same
   ☐ increases, decreases

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5. When standing at a distance of 3.0 m away from a stereo, the sound is 65.0 dB. Assuming that the sound is emitted isotropically, what is the total power output of the stereo? Write your answer with 2 sig. fig. in mW. Recall the threshold of hearing is 10^{12} W/m^2 (the intensity corresponding to 0 dB).

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6. A 7.0-cm-diameter pipe narrows to half its initial diameter. Liquid flows through the 7.0-cm section at a speed of 4.0 m/s. What is the speed of the liquid in the second segment, and what is the volume flow rate through the pipe?

   ☐ 2.0 m/s in the second segment, and a total flow rate of 0.015 m^3/s.
   ☐ 2.0 m/s in the second segment, and a total flow rate of 0.062 m^3/s.
   ☐ 16.0 m/s in the second segment, and a total flow rate of 0.015 m^3/s.
   ☐ 16.0 m/s in the second segment, and a total flow rate of 0.062 m^3/s.

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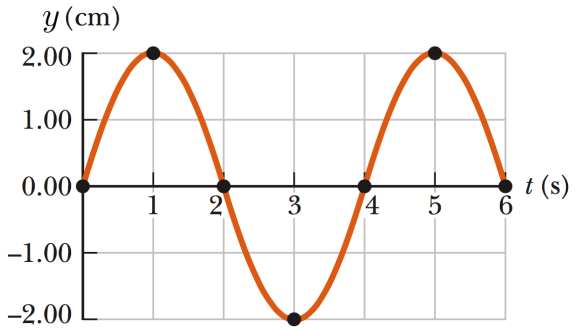
7. The figure below shows the displacement $y(x = 0, t)$ for a transverse wave on a string. To one sig. fig., what is the maximum particle speed?



- ☐ 1 cm/s
- ☐ 2 cm/s
- ☐ 3 cm/s
- ☐ 4 cm/s
- ☐ 5 cm/s
