Assignment X, PHYS 101 (Introductory Physics I)
Fall 2020
Due via pdf upload to OAKS prior to *FRIDAY*, December 4th at noon

General instructions:
Same instructions as usual. For this, and all other homework assignments, please turn in your solutions with all supporting work; answers without supporting work will not earn credit.

Suggested additional (ungraded) practice problems
Chapter 11: https://openstax.org/books/college-physics/pages/11-problems-exercises
Problems from sections 11.2, 11.3, 11.4, 11.6, and 11.7
Chapter 12: https://openstax.org/books/college-physics/pages/12-problems-exercises
Problems from sections 12.1, 12.2
Chapter 16: https://openstax.org/books/college-physics/pages/16-problems-exercises
Problems from sections 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9
Chapter 17: https://openstax.org/books/college-physics/pages/17-problems-exercises
Problems from sections 17.2, 17.5
Chapter 13: https://openstax.org/books/college-physics/pages/13-problems-exercises
Problems from sections 13.1, 13.2
Chapter 14: https://openstax.org/books/college-physics/pages/14-problems-exercises
Problems from sections 14.2, 14.3
Chapter 15: https://openstax.org/books/college-physics/pages/15-problems-exercises
Problems from sections 15.1, 15.3, 15.4, 15.6, 15.7

NOTE – I know this is a lot, and I'm writing this prior to Thanksgiving so I'm not sure how far through this material we will actually end up getting. At the end of the semester, I'll give you some additional guidance what elements of the above suggested problems are really fair game and which we haven't gotten to in time. The above is an optimistic list – though we already have covered the content from Chapters 11, 12, and most of 16 even now before Thanksgiving break. Also notice that there are only selected topics chosen from the other chapters.

I also made this homework shorter than normal so you can focus on breadth for this material rather than depth.

1. It takes a pressure of about 300 pounds per square inch to crush a (full) soda can. How deep below the surface of the ocean would you have to bring a soda can so that it would be crushed?
2. A horizontal mass-spring system has spring constant $k = 13000\text{N/m}$ and an attached mass $m = 2$ kg. The spring is stretched to a length 4.5 cm beyond its equilibrium point and then the mass is released.
   a) How much total mechanical energy is in this oscillator?
   b) At some time after the mass is released, it is moving at an instantaneous speed of 3.0 m/s. How far is the spring from its equilibrium position at that time?

3. The moment of inertia of a hoop of mass m rotating about its EDGE is equal to $2mR^2$ where R is the radius of the hoop. A circular hoop having mass 350g and with radius $R = 12cm$ is hung on a nail and then perturbed so that it oscillates back and forth.

   a) How long does it take the hoop to complete a full oscillation back and forth? (aka what is the period of oscillation of the hoop?)

   b) If you wanted to make a simple pendulum that oscillated with the same period, how long would it have to be?

4. The speed of sound in (dry) air can be approximated with the equation:

$$v_{\text{air}} \approx (331.3 \text{ m/s})\sqrt{\left(1 + \frac{\theta}{273.15°\text{C}}\right)}$$

   where θ is the air temperature (in degrees Celcius). In a 10 degree Celcius room, what is the wavelength of the main tuning note for most Orchestras (A-440, which has a frequency of 440 Hz)?

5. The speed of sound in water is 1481 meters per second. A particular sound wave has a wavelength of 12 meters.

   a) What is this wave's frequency?

   b) What is this wave's angular frequency ω?

   c) What is this wave's wave-number k?

6. This semester has been challenging for all of us, and I know most of you are doing all you can. I also know that few of you view Physics as your professional calling like I do, and that's totally ok. My goal was to teach you a little bit of physics and (hopefully) also a bit about critical thinking and problem solving that you can can apply in a non-physics context as well.

   This last problem is meant to be more or less a freebie for y'all – write down at least 3 things that you learned in this class this semester that you promise me you'll remember for the rest of your life. No equations, please! As long as you write things that are objectively and factually correct (and relevant), you'll earn full credit for this problem. Word your answer carefully; I can't give full credit to something that is not quite true!