Your Name: _____

Teammates: _____

Physics 8, Fall 2023, Worksheet #28.

http://positron.hep.upenn.edu/p8/files/ws28.pdf

Upload PDF (smartphone scan or tablet edit) to Canvas shortly after class on Mon, Dec 11, 2023.

Problems marked with (*) must include your own drawing or graph representing the problem and at least one complete sentence describing your reasoning.

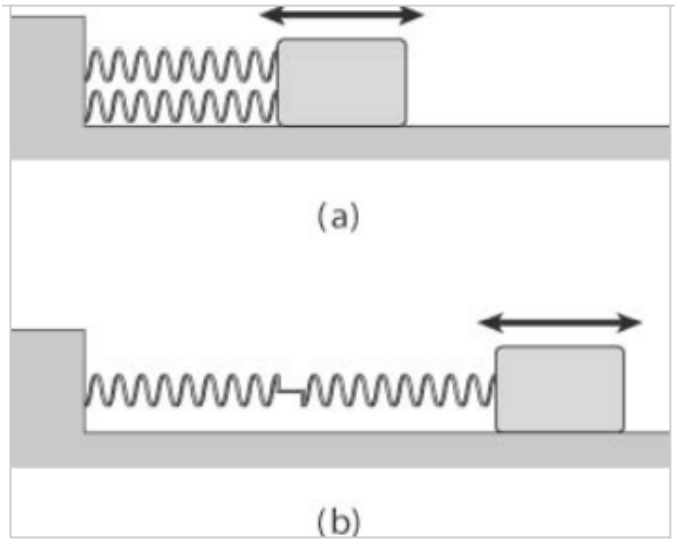
Discuss each problem with your teammates, then write up your own solution. Be sure to compare final results with your teammates, as a way to catch mistakes. It can also be very interesting when you and a teammate use different methods to arrive at a result. Do not hesitate to ask for help from other students or from the instructors — but don't just copy down other people's results!

1. Hands-on activity! Ryan is going to cook up something fun involving our two favorite examples of oscillating systems: the pendulum; and the bob suspended from a spring.

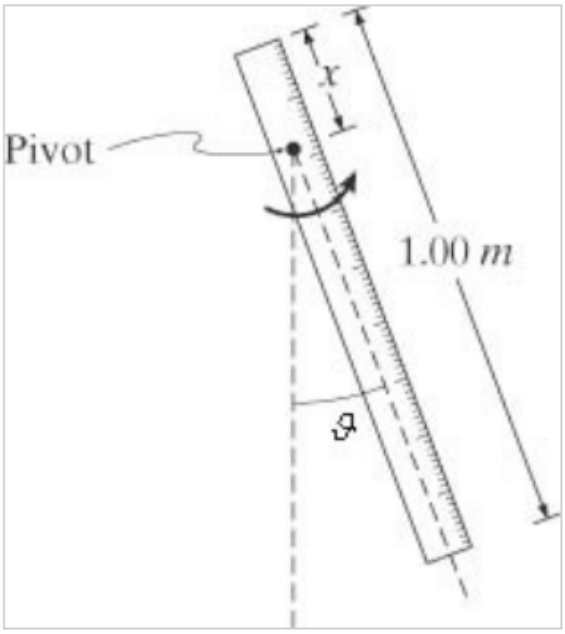
2. A pendulum is swinging with period $T = 1.0$ s in a stationary elevator. What happens to the period when the elevator (a) accelerates upward at $a_y = +2.0$ m/s^2 ? (b) accelerates downward at $a_y = -2.0$ m/s^2 ? (c) travels downward at constant velocity $v_y = -5.0$ m/s ? (d) travels downward and gradually slows to a stop ($|a_y| = 0.5$ m/s^2 — should it be positive or negative)? The easiest way to analyze this problem is to notice that when you are on an elevator, the constant "g" is effectively replaced by a value that combines g with the vertical acceleration — combines how? (Think of what happens when you are standing on a bathroom scale while riding an elevator.)

3. (a) To form a pendulum, I put a 1.50 kg mass at the end of a 0.248 m long cable. If I give the pendulum a small kick and then let it move back and forth freely, what is the period of oscillation? (b) If I replace the 1.50 kg mass with a 15.0 kg mass, how does this affect the period of oscillation? (c) If I wanted to make the period of oscillation twice as large, how long would I have to make the cable?

XC4*. A horizontal spring-block system made up of one block and one spring has an oscillation frequency $f = 1.5$ Hz. A second spring, identical to the first, is added to the system. (a) What is the new oscillation frequency when the two springs are connected as shown in figure **a** below? (b) What is the frequency when the springs are arranged as in figure **b** below?



XC5*. A meter stick is free to pivot around a point located a distance x below its top end, where 0 m $< x <$ 0.5 m. (See figure above.) (a) What is the frequency f of its oscillation if it moves as a pendulum? (b) To what position should you move the pivot if you want to minimize the period?



XC6*. You have a teardrop-shaped 2 kg object that is 0.28 m long along its longest axis and has a hook at one end. When you try to balance it on your fingers, you find it balances when your fingers are 0.20 m from the hook end. Then you hang the object by the hook and set it into simple harmonic motion. You find that it oscillates 10 cycles in 13 s. What is its rotational inertia I?