Please answer the questions below to the best of your ability either in the space provided. Everything should be scanned or photographed and submitted through gradescope.com. **If you do not specify what pages correspond to what problem parts on Gradescope, I will not be grading your assignment until you do so!**

Objective: *I can use utilize pressure to determine forces on an object.*

Objective: *I can use analytic spring equations to determine physical properties of an object.*

1. Some of my favorite Mythbuster explosions are those of pressurized water heaters. (Example: https://www.discovery.com/tv-shows/mythbusters/videos/exploding-water-heater). Consider a water heater that is approximated by a cylinder 2 meters long and with a radius of 63 cm. For the sake of this problem, assume that we are pressurizing the heater with air, and not water, so that we don't have to consider the more considerable mass of the internal water.

(3) (a) When you originally come across the water heater, you are unsure of its mass. There is a large spring nearby that is conveniently labeled with a spring constant of 1000 N/m so you hang the water heater from the end of the spring. Unfortunately, you forgot your meter stick, so you have no method of measuring how far the spring stretches. Instead, you pull the heater slightly past the equilibrium point and then let go, watching it oscillate up and down. You use your watch to determine that it takes the heater 1.72 s to complete one oscillation. What is the mass of the water heater?

(2) (b) With the mass known, you take the heater off the spring, roll it over to a nice flat location, and hook up an air compressor. The heater is capable of withstanding an internal pressure of 2.3 MPa before exploding out the bottom. When the heater explodes, what force will the pressure initially exert downwards?

(4) (c) During the explosion, the pressure rapidly, and linearly, decreases to zero. Quantitatively it looks like

$$P = 2.3\,\text{MPa} - (1.15\,\text{GPa/s})\,t$$

where the pressure decreases to zero in 2 ms. (Note that the above equation is only valid over those 2 ms, it doesn't go negative after that fact...) At the end of the 2 ms explosion, how fast is the heater moving upwards?

(3) (d) Determine the maximum height the heater reaches if after the explosion only the force of gravity is acting on it.

(4) (e) Suppose instead the heater fell over seconds before the explosion, such that it fired horizontally instead of vertically. If the coefficient of kinetic friction between metal and concrete is about 0.58, how far does the heater travel before sliding to a stop? (Assume it is not rolling during this interaction, merely sliding.)