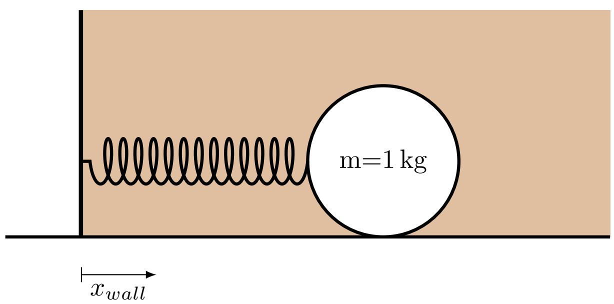
Questions from Taylor, Chapter 5. Please show all your work and write legibly for full credit! These will be due on Monday, September 28 at midnight.

- **5.2**: Practice with potential energies and Taylor expansions. Your life will be a lot nicer here if you expand the exponential to it's Taylor Series inside the expression, keeping only the necessary terms, before dealing with any of the squaring. Or have Sympy assist you. Also, when it says "sketch", choose some values for the constants and plot it. The expression blows up pretty hard at 0, so you may want to add a `plt.ylim(low, high)` to ensure you can see anything interesting.
- **5.18**: The shown image here is a top down image, so you do not need to be messing around with any gravitational potentials here. You may want to consider taking your Taylor expansions earlier rather than later, and either way may want to do them on a computer.
- **5.26**: Basic Damped Oscillators
- **5.43**: Practice with resonance
- **World's Worst Mixer**: Consider the case of a small mass moving through molasses which is connected via spring to a moving wall.




The wall oscillates back and forth according to

$$x_{wall} = A \sin\left(\frac{2\pi}{T} t\right)$$

where $A$ is 10 cm and $T$ is $\pi$ seconds. The spring has a spring constant of 25 N/m and a relaxed length of 30 cm. The mass has a mass of 1 kg and a radius of 2 cm (image not to scale!). Molasses has a viscosity of about 6 N s/m$^2$. For linear drag cases such as this, the linear drag coefficient $b$ is approximately:

$$b \approx 6\pi r \eta$$

where $r$ is the radius and $\eta$ the viscosity (From earlier homework). The mass is initially 5 cm from the wall and at rest.

a) Starting from your sum of the forces, determine $\beta$ and $f(t)$ and write down the equation of motion for the small mass. Be sure you are clear as to what coordinate system you are using. Where are you calling the 0 position of your mass?

b) Solve for the motion analytically and plot the location of the mass over 15 seconds. Does the mass ever strike the moving wall? Provide evidence for your conclusion.

c) **Extra Credit (3pts):** Simulate the motion computationally using the Euler-Cromer method. You'll need to compute the spring force every iteration to account for both the moving mass and the moving wall. Compare your computational results here to your analytic results graphically.