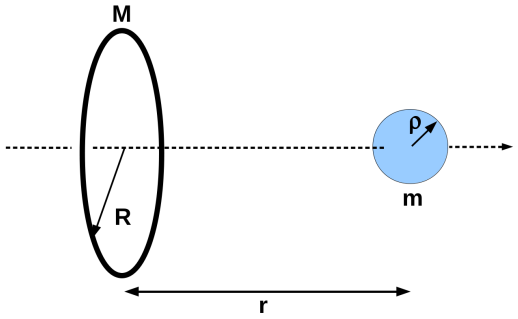
Physics 3210, Spring 2019 Homework #3

Due *in class* Thursday January 31st

1. You are pressing a book against a wall with your hand. What is the direction of the friction force which the book exerts on the wall? Explain, using a free-body diagram.

2. Calculate the gravitational force of a ring of mass M and radius R on a sphere of mass m and radius ρ, separated by a distance r. Set up and solve the integral. Use a *Taylor Series Expansion* to show that you obtain the expected result in the limit $R << r$.

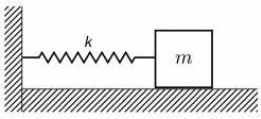


3. *K&K* Problem 3.17.

4. The viscosity of milk is about 3.0 kg/(m s). Plot, as accurately as possible, the velocity versus time of a baseball released from rest, below the surface of the milk, at $t = 0$. (You'll need to look up the mass and radius of a baseball.) What is the terminal velocity, and what is the time τ it takes to reach this velocity?

   (Why one would want to drop a baseball into a tank of milk is anybody's guess, but if you ever do you'll know what to expect.)

5. A block with mass $m = 2.0$ kg slides on a frictionless surface as shown. It is connected to the wall by a spring with spring constant $k = 0.15$ N/m. It is given an initial speed $v_0 = 0.5$ m/s to the right and an initial displacement $x_0 = 0.4$ m to the left of the equilibrium position.



   (a) Calculate the acceleration of the block at $t = 6.1$ seconds.

   (b) Carefully graph the position and velocity of the block as a function of time after it is released. Be sure to indicate the amplitude and period of the oscillation along with the initial conditions.

6. *K&K* Problem 3.19.

7. *K&K* Problem 3.21. Note that the expression for r contains a typo: Should be

$$r(t) = Ae^{-\gamma t} + Be^{+\gamma t}$$