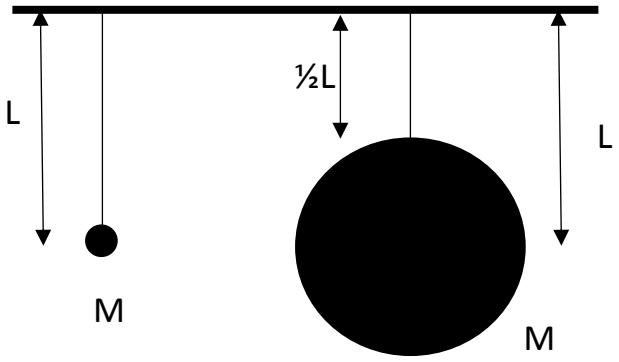
Physics 1135: Homework for Recitation # 24: Harmonic motion

1. A toy figure of mass 2.0kg is at the end of a horizontal spring of spring constant 200N/m on a frictionless horizontal surface. The toy is pulled, stretching the spring a distance 6.0cm from equilibrium, and released from rest.
Find the angular frequency and the period of the oscillation. What is the maximum speed reached by the block?

2. A cork at the end of a spring oscillates with an angular frequency ω= 5.0 rad/s. At t=0, the cork is at position x=2.0cm and is moving with speed 20cm/s in the negative x-direction. The position can be described through the equation $x=A\cos(\omega t+\varphi)$. Find the amplitude A and the phase angle φ.

3. A mass at the end of a spring is undergoing simple harmonic oscillations with amplitude A.
a) What fraction of the total mechanical energy is kinetic if the displacement is ⅓ the amplitude?
a) In terms of A, find the value of displacement x at which the potential energy equals $^1/_{16}$ of the total mechanical energy.

4. Two pendula consist of a uniform ball of mass M each, suspended from a massless string as shown in the figure. The ball of the left pendulum is very small. The ball of the right pendulum has radius ½L.
a) Find the period of each pendulum.
b) How do the periods change when the mass of each pendulum is doubled?



5. A uniform rod of mass M and length L is pivoted at a distance x from its center and undergoes harmonic oscillations.
Derive an expression for the rod's period T for small oscillations about its pivot point, in terms of M, L and x. In terms of L, find the value of x for which the period is a minimum.