**PHYS 101**

**Homework # 12**
**DUE DATE: December 22, 2009**

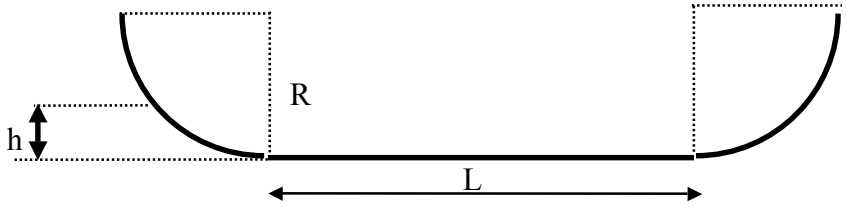
Please do not submit copycat answers from the solutions book or some other solution you have in hand. You should at least show your understanding of the problem. Otherwise, this will be considered as cheating.

1) Compare the performances of two clocks. The first clock is based on a single pendulum, the second on a torsional pendulum. Assume that the clocks are calibrated to show the correct time at a certain point. Compare the performances when the clock are taken to a different environment where
a) The elevation is different
b) Humidity is different
c) Temperature is different

2) a)What is the change $\Delta T$ in the period of a simple pendulum when the acceleration of gravity g changes by $\Delta g$?
b) What is the fractional change in period $\Delta T/T$ in terms of the fractional change $\Delta g/g$?
c) Explain how one can use a pendulum to determine the gravitational constant at different elevations using the above result.
d) A pendulum clock, which keeps correct time at a point where g=9.800 m/s2, is found to lose 5.00 s each day at a higher elevation. Use the result of part b to find approximately the value of g at this new location.

3) A box (of mass m) is left from a height h in the following diagram. The box first moves on the surface of a circular arc (of radius R) and then on a plane region of length L, and then climbs to a similar circular arc (of radius R). Assume that the gravitational acceleration is constant and equal to g, during the entire motion (h <<R).

a) (15 points) Assuming that there is no friction, the box will make a repetitive motion. What is the period of this motion?
b) (10 points) If the frictional coefficient of the plane region (of length L) is equal to $\mu$, the box will eventually lose all of its energy to friction. Estimate the time the box will stop? (there is no friction on the curved surfaces).



4) A rod of length 4L consists of steel rod of mass 4M, bent into the shape of an square of length L on each side (so each side has a mass of M). This square is suspended from one its corners.
a) Make a detailed analysis of the problem

b) What is the moment of inertia of the square about an axis through this corner and perpendicular to its plane? You can use the moment of inertia formula for a rod.

c) (Use problem solving techniques) A small disturbance is applied to the square, and it starts an oscillatory motion about the same axis under gravitation. Determine the natural frequency of this oscillation for small amplitude oscillations.

d) Make the checks of your results.