# Phys601/F11/Problem Set 5 Due 10/10/11

**From Goldstein et al (3d Edition)**
Ch 3 #s 11, 20

## 5.1H

A string of length L > 2 is strung from x=-1 to x=+1. Find the shape of the string *y(x)* which would maximize the area between the curve and the x-axis for fixed L. Describe the shape you get. Show that the limits L -> 2 and L >> 2 make sense. What is special about L=π?

## 5.1Q

Part I Problem 1.

A particle of mass $m$ moves in a circle under the influence of a central attractive force,

$$F(r) = -(K/r^2)\exp(-r/a) \tag{1}$$

where $K$ and $a$ are constants.

(a) What is the effective one-dimensional potential $V_{\text{eff}}(r)$ for the radial motion, accounting for the fact that $\ell$, the angular momentum of the particle, is constant for a central force? (You do not need to solve explicitly for the potential $V(r)$ associated with $F(r)$) [3 points]

(b) What are the general mathematical conditions that an effective potential must satisfy in order that the circular motion be stable? [3 points]

(c) Determine the relation between the radius $R$ of the circular motion in the force field (1) and the constant $a$ such that the circular motion is stable. [7 points]

(d) Determine the frequency of small radial oscillations about this circular motion in terms of $m$, $a$, $\ell$ and $R$. [7 points]