PHY509: HOMEWORK 10. (due 12/09/05)

P1. A planet is revolving around the sun in a circular orbit with radius R. The central force between the masses is the Newton's gravitational force $F = -k/r^2$. Assume that the sun's mass is much larger than the planet's and the position of the syn does not move.

(a) If the sun's mass is reduced in an instant to half of its original mass, what is the resulting orbit of the planet?

(b) If the sun's mass is reduced adiabatically to half of its original mass, what is the resulting energy of the planet?

(c) In the case of (b), what is the resulting orbit? Prove your answer by using the adiabatic theorem.

P2. Consider a point mass moving on a line with the potential field ($f > 0$)

$$V(x) = \begin{cases} +\infty, & x < 0 \\ fx, & x > 0. \end{cases}$$

(a) Using the Newton's equation $F = m\ddot{x}$, solve for $x(t)$ at an energy E.

(b) What is the period of the system?

(c) Calculate the period from the action-angle variable theorem and show that it agrees with the result from (b).

(d) If $V(x) = f|x|$, what is the new period? Use the action-angle variable theorem.