HW#3 —Phys374—Spring 2008
Due before class, Friday, Feb. 22, 2007
www.physics.umd.edu/grt/taj/374c/

Prof. Ted Jacobson
Room 4115, (301)405-6020
jacobson@physics.umd.edu

1. **Equation of motion for a stretched string**: In class we derived the equation of motion for a stretched string by applying Newton's law to each bit of string. This is also called the one-dimensional wave equation. The derivation is written up and posted at the supplements link to the course web page. (I just posted a 2008 version, which modifies somewhat the 2007 version.) For this homework, do the four exercises, **a**, **b**, **c** and **d** that are included with that supplement. [4+3+3 +(3+3+4)=20 pts.]

2. **Convergence of improper integrals**

   (a) Show that $\int_1^\infty dt\, t^n$ is finite if and only if $n < -1$.

   (b) Show that $\int_0^\infty dt(a+bt)^n$, with $a, b > 0$, is finite if and only if $n < -1$.

   Be careful to treat the $n = -1$ cases properly. [5 pts.]

3. Consider a particle of mass m in one dimension with a positive velocity v, acted on by a force that depends on the velocity as $-bv^n$, where b is a positive constant and n is a positive dimensionless number. This force acts to slow the particle down.

   (a) Use dimensional analysis to find an expression for how (i) the time for the particle to come to rest, and (ii) the distance it travels before coming to rest, can depend on the initial velocity v_0, together with m, b, and n. [5 pts.]

   (b) By integrating Newton's law, determine for which values of n the particle comes to rest in a finite time, and determine that time. Compare with part 3a. [5 pts.]

   (c) Determine for which values of n the particle travels a finite total distance before coming to rest (whether or not it actually stops in a finite time). Find an expression for that distance and compare with your result from part 3a. [5 pts.]