Math 207C
Homework 2
Due Friday, April 20th

1. Find the two-term asymptotic expansion for small ϵ for all real roots x of the below equations.

   (a) $\epsilon^2 x^3 - x + \epsilon = 0$

   (b) $\epsilon \exp(x) = 1 + \dfrac{\epsilon}{1 + x^2}$

2. Suppose the position, $x(t)$, of a mass on a damped linear spring obeys the following equation

$$m\ddot{x} + b\dot{x} + kx = 0,$$

   where m, b, and k are constants representing the mass, damping coefficient, and spring constant, respectively.

   (a) Each term in the above equation has dimensions of force. Identify the dimensions of b and k in terms of mass, length, and time.

   (b) Identify the three different time scales in the problem, and for each time scale discuss its physical meaning.

   (c) Present two different nondimensionalizations: one appropriate for the limit of vanishing friction and the other appropriate for the limit of vanishing mass. Identify the small nondimensional parameter in each case.