your name(s)_____

Physics 831 Langevin Program - Monday/Wednesday, Oct. 23/25 2017

Work in groups of two:
Consider a particle moving in one dimension of mass m. At a time $t = 0$ it is at the origin with velocity v_0. It feels a series of small momentum impulses at each small time step Δt. The impulses are random with Gaussian distributions and variance σ^2. The particle also experiences a drag force, $F_d = -\gamma p$.

1. Write a program (in C++ or python) that simulates the motion of many such particles, all beginning with different initial velocities, where $\langle v^2(t = 0)\rangle = T/m$. Treat m, γ, Δt as variables, but for the purpose of comparison, set them to $m = 1.0$, $T = 1.0$, and $\gamma = 0.5$ and $\Delta t = 0.005$. Set σ to be consistent with the other variables. The program should evolve until $t = 10$.

   (a) Calculate $\langle v^2\rangle$ as a function of time, where the average is over the many sample particles. Print out the result for every 0.1 units of time. Show that the result is consistent with the thermal excitation value.

   (b) Calculate $\langle x^2/2m\rangle$ as a function of time. Print out and graph the result for every 0.1 units of time.

   (c) Work out problem number 16 from Chapter 4 of the lecture notes, and compare your graph to the analytic result. Compare to both the exact analytic result, and the result assuming the diffusion equation. Incorporate these two comparisons into your graph from (b).