

Physics 480: Homework #1  
Due September 15, 2010  
10 points

1. (4 points) Consider a random walk in 1 dimension. Show that for each small jump, only the parameter  $\langle \Delta x^2 \rangle$  is important when observations of position are made after many small steps. To do this, simulate a random walk using step sizes where the magnitude is either: (1) always a single value, (2) drawn from a uniform distribution, or (3) drawn from a normal distribution. In each case  $\langle \Delta x^2 \rangle = 2D\tau$  where  $D$  is an arbitrary diffusion constant and  $\tau$  is the time between jumps and  $D$  and  $\tau$  are held constant through all simulations. If the particle starts at  $x = 0$ , show the distribution of positions after 100 steps by making many simulations. Plot the histograms for each step size distribution together with that expected for a diffusing particle with diffusion coefficient  $D = \frac{\langle \Delta x^2 \rangle}{2\tau}$ . Submit your code by e-mail along with the rest of the assignment.
2. (3 points) Nelson problem 4.3: Limitations of passive transport.
3. (3 points) Give an example base pair sequence of single stranded DNA that could form a 'hairpin' type structure.