PHYSICS 104B, WINTER 2010
ASSIGNMENT TWO

Due Thursday, January 21.

Your homework solution should include a hardcopy of the code, answers to the questions, and the indicated figures. Commenting your code is strongly encouraged.

[1.] Write a program to solve the one dimensional diffusion equation numerically. Run your code for a delta function initial condition. Compare it with the exact solution by plotting numerical and analytic solutions together. You may have to try different choices of the space and time discretization scales to get agreement.

[2.] Suppose the diffusion "constant" instead depended on position. Modify your code in problem [1] for a case where D decays exponentially as one moves away from the origin: $D(x) = e^{-|x|/\lambda}$. What do you expect to happen? Will particle spreading be less or more rapid? Run your program and check your guess. Make a plot of $\Psi(x,t)$ versus x for some fixed t and three choices of λ. Make $\lambda = \infty$ one of your choices. This of cource corresponds to the usual case of constant D. Is the general λ problem one you can solve analytically? (Try separation of variables again.) Can you state a physical principle for why the 'old' spatial solution e^{ikx} might be expected to fail when the diffusion constant depends on position?